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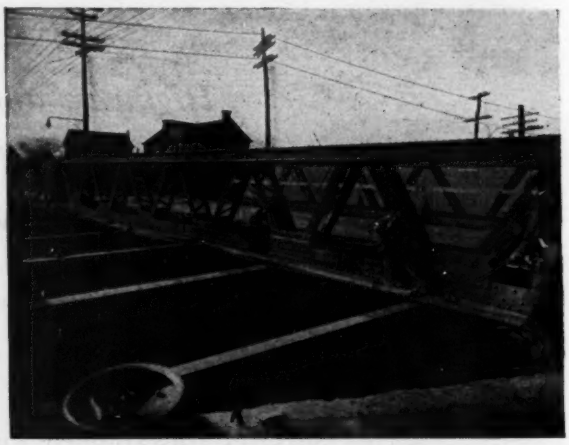

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Highway and Construction Number

Eleven leaders in roadbuilding and construction write on major problems of the current year

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Leaders of Construction

THE LEADERS of construction are preparing to gather in Detroit, for this year the annual road-builders' convention and road show has been transformed into a Highway and Building Congress. Public officials, contractors, manufacturers and engineers are convening simultaneously. A common economic pressure overshadows their separate technical interests. This first joint meeting may find them unready to cooperate effectively, yet it is plain that events call upon them to seek for stabilization of their industry as a whole, and unless they make progress toward that end the spirit and effort embodied in the Congress will be largely wasted.

THAT their service lacked stability has long been known, though often only unconsciously. Forgotten during the rising tide of the last decade, the sharp contrasts of the depression soon brought it to mind, and the stoppage of regular growth of community facilities during the past year gave it sensational emphasis. In the present ebb of construction a deficit in essential facilities is being piled up that means a compensating return later on to boom demand and speculative inflation of construction. Such feast-and-famine fluctuations spell inefficiency, disorganization and unsound practice, and should be stabilized by wise advance planning.

AND NOW the highway field enters a critical state. Fallacious views of economy that have taken root in businessman and citizen alike are causing highway funds to be turned over to charity departments for the purpose of supplying doles to those thrown out of work by stoppage of road construction. Such unreasoned aberrations of thought are intensified by new factors of disturbance—by problems of transportation service methods, regulation, taxation and maintenance. The influences that now impinge on highway construction, as sketched in a series of articles in this issue, are characteristic of the attacking forces to which every field of construction is exposed. No preparation has yet been made for defense.

STABILIZATION is quite obviously needed in the highway field. Plan and program are essential, and these in turn must rest on full information, analysis of economics, value and cost, and realistic appraisal of the service which construction renders to the community. And finally it is necessary that the facts developed by such study, and the plan and program built upon them, be made widely known by proper educational effort.

AMPLE experience has shown that, separately, the scattered interests concerned in construction are unable to make headway in this direction. So long as the engineer, the public official, the manufacturer and the contractor were assembled only in segregated groups they could accomplish little. Not in the highway field alone but in every department of construction there was lacking the indispensable strength of unity in thought and action. Now that hard fact has forced upon the industry a definite realization of its weakness, the way is prepared for effective marshaling of forces.

Unless this result comes out of the Congress, we repeat, it will be largely wasted effort. Detroit can be just another convention. Or it can be the birth of a united construction industry. Which it is to be depends on the vision and force of the leaders of construction.

ABOVE ALL, it is for these leaders to inspire in every individual and unit group of the industry a new spirit of courage, a revived faith in that indomitable enterprise which built a country and a nation—its every homestead, city and highway. The future is destined to be far greater than any dream of the past, and it remains for a virile, enthusiastic and able construction industry to create that future. —THE EDITORS.

Regulation of Road Business Lacks Necessary Unity

Vital problems in vehicle licensing, control of traffic, incidence of taxation, safety of vehicle movement and adjustment of road and rail transportation are being met without unity of thinking or practice

By Thomas H. MacDonald
Chief, Bureau of Public Roads, Washington, D. C.

IN THE course of a single generation the entire pattern of land transportation in the United States has changed. In place of the draft animal we have the motor vehicle, which, for practical purposes, is an equally flexible mode of transport, has greater capacity, much higher speed and a larger radius of operation. Our people have grasped this form of transportation with avidity, both for pleasure and for business, for private and for commercial purposes. Our steadily increasing national wealth has permitted and justified a concomitant extension of our state and local highway improvements to meet the broader potentialities of motor transport. Today we have the accomplished fact of the motor truck and the motor passenger-carrying vehicle as definite elements in our national transportation equipment.

With this change have come many problems. These range from local traffic and parking regulations to the broadest interstate questions involving reciprocity in the recognition of state laws, fees and licenses, and to matters of interstate commerce both by private and common carriers. The fact that the motor truck and passenger bus may operate for hire and profit on the public roads, and that they may occupy a competitive place with other forms of commercial transport introduces a series of problems spreading over the entire field of taxation. The development of all classes of motor transportation has been so great and the use is now so extended that questions of public safety on the open highway are added to the diverse and perplexing problems raised.

Licensing practices

The great flexibility of motor-vehicle operation has so completely obliterated township and county lines and is so capable of dimming state lines that it would seem that the states would by a natural impulse of enlightened self-protection take every reasonable step to conform to the obvious requirements of this new transportation and its proper control.

That they have not "obeyed that impulse" is shown by even a cursory examination of existing state regulations. Each state has attacked the problem from its own standpoint, and without much consideration of the effect its legislation may have upon vehicles entering it from other jurisdictions. It may be said, in fact, that the only regulation upon which there is effective uniformity in all states is that of the registering of vehicles and the issuance of identifying license plates. Beyond that, the broad field of control is occupied by a great number of diversified statutes and rulings.

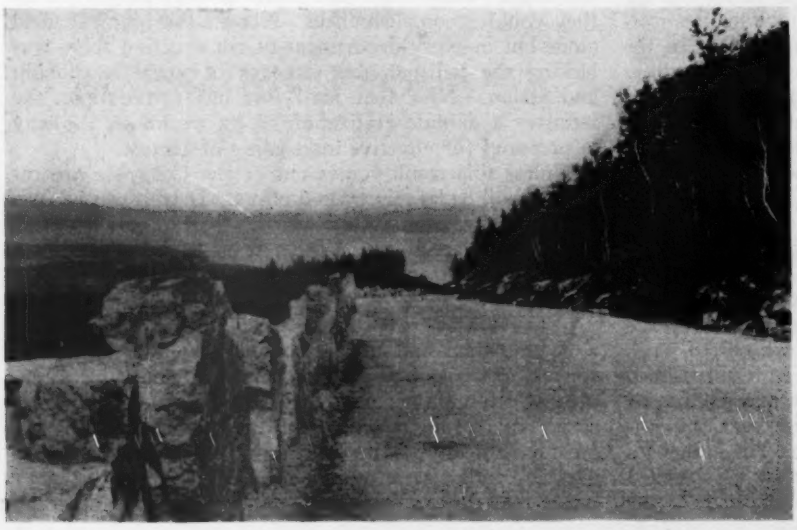
While all states register motor vehicles, only 19 have created an office of commissioner or registrar of vehicles for this purpose, the others assigning these duties to various state officers or departments. To provide legal proof of ownership and to protect the vehicle against theft, 22 states and the District of Columbia have adopted laws requiring a certificate of title for all owners. The fundamentally important provision for an operator's license is found in the laws of only 25 states and the District of Columbia, and only 19 of these require any kind of examination of applicants for license.

As a means of insuring compensation for injury or damage in cases of accident, 19 states have adopted a law that exacts proof of financial responsibility, either by posting collateral, taking out bond or obtaining insurance, on the part of any person convicted of a major traffic offense before his license or permit to operate is restored. One state (Massachusetts) imposes compulsory insurance upon all drivers.

Traffic regulation

The regulating of traffic has received attention to greater or less degree in all states, but with considerable divergencies on certain points. For example, only 31 states and the District of Columbia have fixed definite speed limits, these varying in the case of passenger cars from 30 to 50 miles per hour. A "reasonable and proper speed" is stipulated in 14 states, with some of them specifying a figure beyond which higher speed is deemed "prima facie evidence of improper driving." Forty states require drivers to use hand signals to indicate their intention of turning or stopping, but the nature of these signals is not uniform.

Limitations on the size and weight of motor vehicles have been set by all states, but in many cases, it must be admitted, without having gone very far into a scientific investigation of highway and traffic conditions. This lack of accurate scientific data is revealed when the great diversity of existing regulations regarding the physical characteristics of vehicles is contrasted with the standardization of the vehicles themselves under mass-production methods of manufacture and the uniform standard of excellence toward which our highway system is steadily progressing. To cite only a few illustrations, the maximum permissible width of a vehicle in the several states ranges from 84 to 102 in., height from 11 to 14½ ft., length of a single vehicle from 26½ to 40 ft., and length of a combination of vehicles from 30 to



Acadia National Park Highway on Mt. Desert Island in Maine, 3.86 miles long, surfaced 22 ft. wide with penetrated macadam of native pink granite, will be opened for traffic July 4, 1933.

85 ft. Even greater variance is found in the matter of weight, which may range from 15,000 to 36,000 lb. gross in the case of a pneumatic-tired four-wheel vehicle, and from 16,000 to 48,000 lb. gross on a pneumatic-tired six-wheel vehicle.

For several years committees of the American Association of State Highway Officials and the National Automobile Chamber of Commerce have worked jointly to formulate a code of regulation of weight, dimension and speed that might find uniform acceptance by all states. As the outcome of these deliberations, the American Association of State Highway Officials, at its recent meeting in Washington, agreed upon the recommendations published in *Engineering News-Record*, Dec. 1, 1932, p. 660.

But it is the control of vehicles according to their business characteristics that presents perhaps the most intricate phase of the motor-transport problem. Part of our difficulty in understanding and rationalizing this question is possibly due to the fact that the present system of regulation rests on an assumption which, from a strictly engineering standpoint, is entirely arbitrary; that is, that all vehicles may be divided into two classes, those privately owned and operated and those operated for hire. The distinction between these two groups has come to be regarded as a proper one in most states of this country, as well as in many foreign lands where the same problem has arisen, on the grounds that an operator using the public highways as a place of business for direct profit to himself should pay more for these facilities than the private vehicle owner who carries his own goods or merchandise, or his own family or friends, in vehicles owned and operated by him only incidentally to his major business.

Under the for-hire group a further necessary breakdown distinguishes between the common carrier, who holds himself out indiscriminately to serve the general public, and the contract carrier, who operates only under contract with separate clients. Detailed consideration of these matters would exceed the scope of the present paper, but it may be noted that 47 states and the District of Columbia now regulate the operation of buses, which are common carriers of persons; 39 states and the District of Columbia have laws regulating the operation of common carriers of property; and 34 states have enacted laws dealing with contract carriers.

Taxing practices

Taxation of motor vehicles reflects diversity in the taxing jurisdictions (federal, state and municipal); in the types of taxes (general, including *ad valorem* taxes levied on the motor vehicles as personal property, and special, including annual registration and license fees, motor-fuel taxes and the like); and in the basis of impost as weight, horsepower, cost price or value, engine displacement, tonnage capacity, and sometimes an arbitrary flat rate or a combination of the above factors. As a result a 3-ton truck may pay from $9.60 to $134 annual registration fee, according to the state in which it is registered; and if operated as a common carrier, the total fee may mount as high as $900 per year.

Tax reciprocity

Reciprocal relations between the states are also non-uniform in character, although the private passenger car enjoys fairly liberal treatment in all jurisdictions. Commercial vehicles, however, generally can operate in states other than the state of registration only under very limited reciprocity, and must register and pay full fees in many states.

The matter of taxation is involved in the broad question of reciprocity. States are naturally jealous to receive some contribution from vehicles from other states that use their roads constructed at high cost, and sometimes their efforts to this end have disrupted commercial traffic and reacted upon their own vehicle owners. A recent instance of this kind occurred in October, 1932, when a new law went into effect in Pennsylvania requiring all out-of-state for-hire truck operators to take out Pennsylvania licenses as soon as they entered the state. Officers at once arrested drivers and impounded trucks in considerable numbers pending payment of the required license fees. New Jersey officials, whose laws offer full year-round reciprocity to all types of vehicles from other states, at once retaliated and ordered that all Pennsylvania trucks, privately operated and for-hire alike, must be licensed in New Jersey immediately upon their entering that state. Other commonwealths surrounding Pennsylvania indicated that they would take similar action. Normal truck traffic across state lines in the affected area came to an almost complete standstill, while shippers and operators besieged their state officials with recriminations and complaints. The situation was cleared up only by a hastily summoned conference and a compromise agreement. Similar occurrences in the past have always demonstrated the natural pressure of commercial highway transport across state lines and its resistance to overly severe restrictions.

But the total amount of interstate traffic after all is a small part of all motor-vehicle mileage. In the case of passenger cars it is probably in the neighborhood of 10 per cent. For trucks of all kinds, surveys in many parts of the United States would seem to indicate that the average is about 7 per cent. The real problem that is most pressing and serious at the moment is that of equitably adjusting motor-vehicle taxes within the state.

This matter has three broad phases. If first we consider the public road system as a whole, a decision must be reached as to the portions of the total cost that may equitably and successfully be placed upon landed property and upon highway transportation itself. Next, when we separate our public highways into the classes indicated by use, by supervising authority, or by any other satisfactory basis of classification, we must determine what part of the cost of each should be paid by the users of the different groups of roads, regardless this time of whether the land or the vehicle is the source of the revenue. Finally, when we classify the traffic itself rather than the highway, we find reason to differentiate between the type of vehicle and the use made of it. It will be a nice problem to come to a definite

Grading Skyline Drive in Blue Ridge national park in Virginia, which will traverse crest of Blue Ridge Mountains overlooking Shenandoah Valley for 60 miles.

conclusion on many points involved in these matters of taxation. We do not yet agree on the fundamentals.

Taxation studies

As an approach to a solution of these matters, the Bureau of Public Roads has cooperated with five states in conducting tax or traffic surveys designed to furnish facts on which sound conclusions may be based. In 1930 a general tax study was conducted in Wisconsin in cooperation with the department of economics of the state university. The incidence of all taxes and their distribution was determined to show just what shifts in funds actually occurred in connection with the highway construction program of that state in 1930. In the following year an extensive traffic survey and a tax study were conducted in Michigan, with the cooperation of the state highway department and the University of Wisconsin, to develop the relation between shifts of tax funds among the political units paying them and the amount of traffic by local elements of transportation. In the year 1932 a cooperative study of the taxes of Illinois was made similar to that conducted in Wisconsin two years before, and in 1932 a survey was started in New Jersey in conjunction with the state highway commission, in which special attention is being given to the several classifications of truck traffic—interstate, intrastate, by private owner, contract hauler and common carrier. This study begun late in the year will continue through most of 1933. While we wait for results, it seems that highway transportation is beginning to take a place as a general tax carrier.

To the highway administrator this tendency is unwelcome, but not so because of selfish or bureaucratic motives in the least. It is an offhand, ill-considered attempt to adjust a most difficult and deeply serious matter. It may indicate that a period of many years will elapse before any really sound or conclusive steps are taken to secure adjustment of the tax situation as it affects highways. The importance of immediate relief in some directions must, however, be recognized, and it is a hopeful indication that some states have limited the period during which additional diversions of motor-vehicle revenues shall continue, and some have met the demand for local relief by assuming obligation for local highway indebtedness. These are, at least, thoughtful ways of meeting an emergency.

Safety regulation

Highway transportation as it affects public safety has been under consideration for many years. Some aspects of the general problem have been successfully met. I think engineers have done their part both in the construction and control of vehicles and in the designing and building of roads to make both of these elements much less responsible for accidents than the personal element represented by the operators of cars and trucks. Widths of traffic lanes, uniformity, regularity and texture of surface construction, clearances, gradients and alignment have been studied and adjusted so that in new roads and in reconstructed sections of old roads little remains to be done to insure the traveler against accidents inherent in the road or pavement. The treatment of shoulders, the use of curbs of the lip type and the width and details of drainage structures have received attention and are adapted to the traffic in all new cases. The one remaining phase of general design that is less commonly applied is the treatment of intersections. Expense alone has prevented highway grade-crossing elimination where existing or predictable traffic indicates that such treatment is desirable. But even here the engineer is ready with designs and construction details that will meet practically any possible case. In some states, conspicuously in New Jersey, such eliminated intersections are notable and extremely satisfactory.

The various organizations that have developed road marking and the standardized system of precautionary signing are now engaged in revising and combining the two manuals issued originally by the American Association of State Highway Officials and the National Conference on Street and Highway Safety, and with the completion of this task the remaining efforts to increase the safety of highway transportation will rest largely with the operating officials. There will have to be devised undoubtedly an adequate, workable system of insurance to underwrite the property and personal losses incident to accidents, and greater effectiveness will have to be secured in licensing only the reasonably competent driver and in policing the public highways to enforce proper regulations. Many of the state officials are fully conscious of the problem presented and are giving the matter the thought and recommending the action appearing most satisfactory under their local conditions. Most of the principles are agreed upon, and the major effort is now directed to practical methods of application. Licensing of all drivers, some form of public liability insurance, an adequate highway police body, and a considerate, intelligent and firm enforcement of law are accepted in principle. A section of the uniform vehicle code is devoted to licensing of chauffeurs and drivers.

Place in transportation

No doubt the important economic problem involved is the adjustment of highway transportation into its proper and deserving place in the national system of communications. History has repeated itself to date, and competition has been emphasized where cooperation and correlation should have been sought. The value and service of truck transportation are established beyond question. The place and need of rail transportation are equally unquestioned. So far as the accomplishment of transportation service is concerned, the two forms of transport should be amalgamated, each to serve the other, each to supplement the other. The law should treat both forms of transport equitably, without restricting either beyond the extent necessary for safety and equal service to all comers. The great flexibility and freedom of movement possible with motor-truck transport should not be curtailed, and the railroads should be relieved equally of requirements that no doubt militate against their most efficient and economical operation when considered, not alone, but as a part of a larger, more extensive and penetrating system of communications.

One of the 45,000 miles of local roads taken over by the state of North Carolina, showing old condition and type of replacement construction performed under state management.

The necessary and inevitable solution cannot be approached exclusively from the point of view of either mode of transport; it must obviously be an adjustment, but not necessarily a compromise. Representative interests are at work now to find, if possible, a common ground, and it is apparent and gratifying that this truly fundamental problem of highway transportation will be considered with greater enlightenment than has prevailed at times in the past.

* * *

Transportation problems so far-reaching as those discussed above by Mr. MacDonald can be solved only if stable highway financing is assured. Today the cornerstone of public roads financing is the motor-vehicle tax. The tolls paid by the road user for service and readiness to serve have set up one of the surest means of income that any class of public works has ever enjoyed. They have made road transportation a going business in which planning and budgeting for current operation and upkeep and future extension could be predicated with reasonable assurance. This assurance is being lost. The road-users' tolls are being hazarded by diversion and excessive rates until highway development is threatened with absolutely uncertain income. Knowledge of the facts, presented in the next article, is the first step in preserving highway income for the stabilization of highway transportation. —EDITOR.

Road Taxes for Roads!

A call to the road user to devote the tolls he pays for transacting his business on the highways to extend the facilities for his own business and not to support other businesses that have failed to maintain themselves

By W. C. Markham

Executive Secretary, American Association of State Highway Officials, Washington, D. C.

THERE has been a road tax in some form or other in this country ever since there has been any tax. Yet at no time in our history has there been a road tax levied and then expended for public schools, hospitals, rivers and harbors or any other laudable public enterprise until the present political era arrived, which prides itself on its keen sense of equity and justice.

When the horse and wagon constituted our sole method of transporting commerce over the highway, all property was taxed for road purposes, unless there were special tolls over specially constructed roads to reimburse private investments in those roads. The amounts collected for roads were not of a sufficient amount to create any jealousy on the part of any other governmental function, and no man was asked to work out his poll tax except by pick, shovel or plow upon the highway. His labor may not have made a better road on which to travel, but at any rate it went for that purpose.

When motor-propelled vehicles changed our methods of transportation, those who invested in these vehicles demanded a better roadbed over which to travel. This meant greater governmental expenditures for roads, and immediately those responsible for raising government revenues checked the whole matter up to the user of motor vehicles. And he paid gladly.

What has been accomplished has astounded the world. We have 75 per cent of the motor vehicles of the world and almost an equal percentage of the world's improved highways. This means that the motor-vehicle owner in the United States has paid in taxes enormous amounts for road purposes. Last year, through motor license fees and a gasoline tax he paid into the several state treasuries almost $640,000,000. This was augmented by federal contributions and other miscellaneous revenue. The road user knows that his expenses are 25 per cent less on an improved road than over a dirt road, and, as each year has added large mileages to the improved highways open to his use, he has paid the bills with satisfied approval.

The popularity of this method of securing road revenues grew rapidly from the beginning, and in a few years not only were all states using it but the rate of taxation per gallon of gasoline was increased by leaps and bounds until today some states have the rate so high that they are really receiving diminishing returns and are suffering from the common crime of "bootlegging" and evasion.

While roadbuilding advanced, other lines of public endeavor expanded; but as the revenues for such expenditures were predicated on income tax and property valuations or tariff, those sources of financial return dried up when adverse conditions came, while the road funds continued with but slight diminution.

Prosperity offered temptation

Governors and legislators, looking about for some "easy money," pounced upon this fund like hungry wolves but passed along the idea that they are giving the lamb to the "needy and distressed." During the year 1932 alone, in many states, road funds have been diverted or "borrowed" to such an extent that the total will amount to at least $250,000,000. It isn't necessary to enumerate the states. They know their names and so do the people who paid the road tax. Where laws do not permit diversion, state funds allotted to counties for roads have been diverted for "bacon," without even attaching any requirement such as "work relief."

Every legislature of the 44 that meet this month will have bills before it to divert motor license fees and gasoline taxes to general government expenses, including doles. Every cent diverted from the proper use of these funds will

A four-lane dual-type Pennsylvania road with 10-ft. concrete lanes on the sides and a salvaged two-lane (20-ft.) bituminous pavement in the center, a typical main-road revamping operation.

increase the number of those who need work and thus lengthen the bread line.

It has been repeatedly demonstrated during the past two years by intensive census taking and studies made in many parts of the country, that roadbuilding, in connection with state roads alone, has furnished employment to not less than one million men annually. Realizing this, the federal government has felt urged to increase its contribution toward roadbuilding temporarily, in order to aid in increasing employment. Two years ago the federal government asked the state highway departments to join in increasing the roadbuilding program for this purpose, and an additional amount of $80,000,000 was provided by the federal government, it being required that the states absorb these funds in a very short time in addition to the regular federal funds. This was accomplished in the working period of a little over six months. Again last year the federal government added $120,000,000 to the regular amounts for a like purpose, which must be expended by July 1 next, and it is demonstrated to everyone that this has greatly aided the employment situation.

However, federal revenues have been greatly depleted the same as state and local revenues. The federal government, being compelled to look about for methods to secure funds for the federal treasury, immediately hit upon the road user as an "easy victim." A 1c. gasoline tax was added to that already being collected by the states, and automobile parts and accessories were also penalized. This amount raised by the federal government exceeds the amount given for roads; and, inasmuch as that is the case, all funds secured by the federal government by the special assessment that is diverted to other federal governmental expenditures constitute just as much a diversion of road taxes for other purposes as that going on in the states.

But that is not all. In the very laudable purpose of bringing aid to the distressed and unemployed Congress created a fund, divided into several parts, under the title of "emergency relief." In the very first section of this bill a sum of $300,000,000 was set up which might be loaned to the states for direct relief. If the governor of a state said he had some hungry people and there were no funds to feed them, he could secure a loan from this fund at 3 per cent interest; and if he does not provide for the repayment of the loan, said loan will be collected by Uncle Sam by deductions made from future federal funds *for roads*. Up to the present time 35 states have borrowed from this fund, one state securing over $20,000,000. This is diversion with a vengence of road funds to other purposes than for roads.

Nobody believes that any of this fund will ever be repaid to the federal government and therefore it means a greatly reduced federal contribution for road work. In view of the fact that the advances of $80,000,000 in 1931 and $120,000,000 in 1932 and the $300,000,000 emergency relief are all to be subtracted from future federal contributions covering periods from five to ten years, one does not need to have any mathematical education above arithmetic to realize that the roadbuilding and maintenance programs of the country face a very serious situation.

Justifying theft

In order to justify themseves, those who are advocating the stealing of these roads funds for other purposes are maintaining that road construction and maintenance have been overdone and that a road holiday under present conditions is justified. But they want the man who uses the roads to continue to pay the price whether or not the roads are constructed and maintained on a continuing roadbuilding program. The fallacy of this argument is evident to anyone who realizes that we have over 2,000,000 miles of roads in this country that are simply dirt without a bottom. There are thousands of people living in the country who have for many years been contributing their share toward road improvements through the motor license fees and the gasoline taxes, hoping that the improved road would sooner or later come by their doors. A study of the advancement made in road construction shows that many thousands of miles are added every year to the improved class, and yet the time is a long way off when all our roads will be improved to the proper satisfaction of the road users. To curtail or withdraw funds directly from the road user for any other purposes whatsoever is an injustice to this class of our citizens that cannot be condoned.

During the past political campaign there were candidates for governor scattered throughout the country, irrespective of political affiliations, who sought votes on the ground that the automobile user was taxed too much both in license fees and gasoline taxes. There is no question but when business conditions are adverse all kinds of expenditure, which would add greatly to the tax burden of the general public, should be temporized to the situation; and it may be that in some instances the gasoline tax is too high. But whatever the rate, there is no justification for the securing of funds from the road user and then expending them for other needs in order that the general budget of the state may be reduced for the purpose of making a political showing.

Roadbuilding multiplies employment

Every cent that the people can afford to pay for road improvements should go not only for that purpose, but such expenditure will aid more in the unemployment situation than an equal amount of money expended in any other way. An increased roadbuilding program always makes more jobs, adds more to general wealth and increases more eco-

DIVERSION OF MOTORISTS' MONEY

New York....	General funds.....	$51,000,000
Ohio.....	Unemployment relief (possible).....	30,000,000
Florida.....	General funds.....	2,000,000
	All of motor fees to school	4,750,000
Texas.....	Schools.....	7,500,000
Georgia.....	Schools.....	2,500,000
Louisiana....	Docks.....	750,000
	Schools.....	750,000
Tennessee....	General funds ($2 of vehicle tax).....	700,000
Illinois.....	Unemployment relief (at least temporarily).	12,000,000
Oklahoma....	Unemployment relief...	2,000,000
New Mexico..	Fish hatcheries.....	15,000
Mississippi...	Seawalls.....	250,000
Iowa.....	County general funds (from motor fees)..	375,000
Minnesota....	General funds (from motor fees).....	60,000
Massachusetts	Local general funds (from gas tax and motor fees).....	5,500,000
Rhode Island.	General funds.....	1,000,000
Indiana.....	General funds (at least temporarily).....	2,000,000
Utah.....	General funds (at least temporarily).....	700,000
		$123,850,000

Keeping wet the straw covering employed in curing a concrete road. Practice recognizes the use of earth, ponding, paper, bituminous coatings and chemical salts for the same purpose.

nomic transportation for more people than any other industry. Expenditure of money for roads does not add to the surplus of goods for which the people would not have the money to pay, a condition which would obtain in many lines of industry; and therefore the employment of men in roadbuilding adds to the capital assets of the nation without creating a surplus of some undesired or unnecessary product. Nevertheless, since more than 90c. of every dollar in roadbuilding goes to labor, it is easily discernible that labor used in roadbuilding creates a demand for a consumption of goods and therefore advances the initial impulse needed by industry for the expansion of its work.

The financial situation in many parts of the country is so serious that some people have become almost hysterical; but it is not necessary, in attempting to meet the financial situation, for any state legislature to impose a tax on property invested in motor vehicles which cannot be used for any other purpose except upon the highway, in order that funds may be secured to meet other demands, however meritorious they may be.

Organize and fight

It seems that it will be necessary for the road users to organize to combat this very determined effort to assess them in a special way to balance the budget of their state or community and let other property go free. We have no quarrel with those who may maintain that all governmental activities shall be put in low gear, but it cannot be overemphasized that whatever funds are raised for roads shall be expended on the roads. If the road user is willing to continue to contribute funds for road construction and maintenance through motor license fees and gasoline taxes, the additional fact should not be overlooked that funds so secured will maintain a stabilized employment situation throughout the country such as the expenditure of an equal amount for any other purpose will not do.

If you do not want your motor license fees or your gasoline taxes to go for any other purposes than for roads, tell it to the man whom you helped to elect to Congress or to the members of your state legislature.

* * *

Motor-vehicle funds for road improvement are seriously endangered just at the time when road transportation is making increasing calls for expenditure to solidify the business. Road investment to date has been centered in the main plant units—the state highway systems. In the next few years many of these units will demand remodeling because of obsolescence. But far exceeding this need comes the demand for developing the subsidiary or feeder-plant units—the local roads. This development introduces new problems in administration and financing that stress the importance of an undepleted road income. It is important to appraise this shifting of highway investment. What is its volume, where is it most active, and what are its implications? —EDITOR.

Highway Demand Is Turning from Main to Local Roads

Main road improvement is at its peak—Local roads are receiving and have a right to more road users' taxes—States should take over all road management—Traffic surveys should determine allocation of improvement funds

By Ben H. Petty
Professor of Highway Engineering, Purdue University, Lafayette, Ind.

DURING the past decade this country has witnessed the most amazing program of high-type road improvement that the world has ever seen. These developments have been centered on our main trunk-line highways in the various state highway systems and have resulted in a marvelous connecting network of high-type paved roads, which has revolutionized modes of travel and has greatly altered standardized methods of freight transportation.

The general agreement and pronounced enthusiasm for the limited scope of this concentrated highway improvement have been almost unanimous. Motor clubs, luncheon clubs, chambers of commerce and similar organizations have vied with each other in accelerating the pace of improvement on our main roads. Results have been marvelous, and most states are now fairly well supplied with trunk lines, paved according to the most advanced highway engineering standards in vogue at the time.

Much of the credit for this successful program is due the U. S. Bureau of Public Roads, which has insisted always on the highest standards of design and construction, emphasized the very great importance of adequate maintenance and fostered research work of untold value to the industry. Under the influence of this bureau the highway engineering departments of the various states have attained high standards of excellence in the fields of business administration, engineering design, construction, maintenance and research. These state organizations can face their taxpayers with a record of achievement that has been rarely, if ever, equalled in the realm of public works.

During the past year or two, however, it has become increasingly evident that we are approaching, or probably have already reached, the peak of state highway development, and are now

Current grading operations employ the most modern types of excavating and hauling equipment; a 60-hp. tractor, 7-cu.yd. wagons and a steam shovel, all crawler-mounted, used on an Indiana highway.

facing a slowing down of the pace in new construction, with future efforts centered largely on widening or resurfacing existing pavements and the building of grade-separation structures where needed, with a corresponding increase in local road improvement.

Sentiment is shifting

Those who have for years been thinking mainly in terms of state highways are gradually awakening to the fact that in almost every community, in addition to the limited mileage of state roads, there are many miles of local roads (the ratio is about 10 to 1), largely unimproved, on which our rural residents must depend almost altogether in gaining access to markets, schools, churches, friends and about everything else that goes to make life worth living. Many of these rural residents have for years supported the state highway program in hopes that they, too, would sooner or later be gotten out of the mud. With the passage of time many of them are realizing that they are no nearer this happy solution than they were ten years ago and are now demanding that we slow up on the main trunk-line improvement and grant to them the boon of a low-cost road surface that will afford suitable avenues of transportation throughout the year.

Another thing that has shifted the spotlight somewhat from state highways to local roads is the business depression with its attendant universal demand for drastic tax reduction. Local road tax has been a very large item in the tax bill of most of our rural communities. By demanding and securing a much greater diversion of gasoline tax and motor-vehicle fees from state roads to local roads many rural communities have been able to reduce greatly or entirely eliminate property tax for local roads. As an example, the special legislative session in Indiana during the past summer transferred all township unimproved roads to the county highway systems, allotted 40 per cent of the motor-vehicle fees and gasoline tax to local roads and eliminated property tax for all local road maintenance in the state. As a result, the property tax in some rural communities has been reduced as much as 60c. on each $100 of taxable property.

PERCENTAGE DISTRIBUTION OF TOTAL GASOLINE TAX AND MOTOR-VEHICLE LICENSE FEES

Percentages are based on total of motor-vehicle fees and gasoline tax allocated to roads and streets.

State	State Roads			(3) Local Roads			(7) City and Town Streets		
	1925	1930	1933 (6)	1925	1930	1933	1925	1930	1933
Alabama	80	60	60	.....	30	30	.....	.....	.....
Arizona	66⅔	70	60	33⅓	30	40	.....	.....	.....
Arkansas	.....	.....	.....	.....	.....	.....	.....	.....	.....
California	50	62	60	50	37	37	.....	1	3
Colorado	50	70	70	50	27	27	.....	3	3
Connecticut	100	100	75	.....	.....	25	.....	.....	.....
Delaware	100	100	100	.....	.....	.....	.....	.....	.....
Florida	.....	.....	.....	.....	.....	.....	.....	.....	.....
Georgia (1)	100	100	100	.....	.....	.....	.....	.....	.....
(2)	60	20	20	40	80	80	.....	.....	.....
Idaho	50	65	54	50	35	46	.....	.....	.....
Illinois	100	79	79	.....	21	21	.....	.....	.....
Indiana	81	75	50	19	18¾	40	.....	6¼	10
Iowa	100	80	80	.....	20	20	.....	.....	.....
Kansas	77.7	77.1	72.3	22.3	22.3	27.1	.....	.6	.6
Kentucky	.....	.....	.....	.....	.....	.....	.....	.....	.....
Louisiana	100	100	100	.....	.....	.....	.....	.....	.....
Maine	100	100	100	.....	.....	.....	.....	.....	.....
								(Baltimore)	
Maryland	80	80	80	.....	.....	.....	20	20	20
Massachusetts	70	70	50	21	19.5	10	.....	.....	25
Michigan	72.3	76.6	31	27.7	23.4	53	.....	.....	16
Minnesota (2)	.....	.....	66⅔	.....	.....	33⅓	.....	.....	.....
Mississippi	.....	.....	.....	.....	.....	.....	.....	.....	.....
Missouri	100	100	100	.....	.....	.....	.....	.....	.....
Montana (1)	.....	.....	.....	100	100	100	.....	.....	.....
(2)	20	75	75	40	.....	.....	.....	.....	.....
Nebraska (1)	30	30	30	70	70	70	.....	.....	.....
(2)	100	75	75	.....	25	25	.....	.....	.....
Nevada (1)	100	100	100	.....	.....	.....	.....	.....	.....
(2)	46.7	.....	.....	53.3	.....	.....	.....	.....	.....
New Hampshire	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Jersey	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Mexico (1)	66⅔	37	45	33⅓	17	15	.....	.....	.....
(2)	100	100	100	.....	.....	.....	.....	.....	.....
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....
No. Carolina (4)	100	60	40	.....	40	60	.....	.....	.....
No. Dakota (1)	10	33⅓	33⅓	90	66⅔	66⅔	.....	.....	.....
(2)	100	66⅔	66⅔	.....	33⅓	33⅓	.....	.....	.....
Ohio	4[illegible]	62.5	56¼	25	25	25	30	37½	18¾
Oklahoma	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oregon	100	100	100	.....	.....	.....	.....	.....	.....
Pennsylvania (5)	83⅓	83⅓	83⅓	16⅔	16⅔	16⅔	.....	.....	.....
Rhode Island	98⅓	98⅓	9[illegible]	1⅔	1⅔	1⅔	.....	.....	.....
So. Carolina	75	88	[illegible]	25	12	12	.....	.....	.....
So. Dakota (1)	50	50	[illegible]0	50	50	80	.....	.....	.....
(2)	100	100	100	.....	.....	.....	.....	.....	.....
Tennessee	.....	.....	.....	.....	.....	.....	.....	.....	.....
Texas	66	74	55	34	26	45	.....	.....	.....
Utah	100	100	100	.....	.....	.....	.....	.....	.....
Vermont	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virginia	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington	98.5	69.7	69.7	.6	29.7	29.7	.9	.6	.6
West Virginia	100	100	100	.....	.....	.....	.....	.....	.....
Wisconsin	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming (1)	.....	100	100	.....	.....	.....	.....	.....	.....
(2)	100	75	75	.....	25	25	.....	.....	.....

(1) Refers to motor-vehicle license fees only.
(2) Refers to gasoline tax only.
(3) The term "local roads" refers to both county and township roads. Some states have both, while some states have only one of these road systems. In conformity with the subject of this article, it seems best to combine both under the general heading of local roads. States having both county and township roads in which funds are allocated to the township unit include California, Iowa, Kansas, Michigan, Massachusetts, Ohio and South Dakota.
(4) North Carolina state highway department absorbed all local roads in 1931. These local roads are classed as secondary state highways, and a definite proportion of the state funds is allocated to this secondary system each year.
(5) Pennsylvania state highway department took over 20,000 miles of township roads in 1931.
(6) Percentage allocations for 1933 are subject to change in those states where legislative sessions are scheduled for 1933.
(7) Refers to funds allotted to city and town authorities not expended under the direction of state highway departments.

Older paved roads often demand shoulder reconstruction to bring them to modern standards. View shows a truck gang hauling and placing new shoulders on North Carolina road.

Burden on the motorist

By shifting the local road burden from property to the motorist and by drastically reducing construction expenditures on state roads where the motorist does most of his traveling, we have helped solve the property tax problem, but we have raised serious questions in the motorist's mind as to whether or not he is being fairly dealt with. Few motorists have questioned the justice of a reasonable gasoline tax and motor-vehicle license fee so long as they were assured that the funds secured therefrom were being wisely spent on improvement of main state highways. That the motorists' travel

is confined largely to state roads is again evidenced by preliminary determinations in connection with the Indiana state highway transport survey, which shows that our state highways carry 65 per cent of the total traffic and that local roads carry 35 per cent.

As the situation now stands, we find motorists in our large population centers paying the major share of all local road-maintenance costs, including those remote communities where these motorists never travel and from whence they receive only indirect benefit from the existence of such roads. Five of the more populous counties in Indiana pay a third of the local road-maintenance bill in the entire state comprising 92 counties. More than half the counties in the state are receiving aid in local road maintenance from the more populous counties. It is quite probable that the next session of our legislature and those of several other states will witness a determined fight on the part of the motorists to secure a reduction in gasoline tax. They, too, want tax reduction.

There are some potent arguments on the other side of the question, however. For instance, the residents of rural communities rightfully claim that these local roads were built and paid for entirely from direct tax on property in the township as a unit. From 1905, when the Three-Mile Road Law was passed in Indiana, until 1930 approximately $217,000,000 was produced by township property taxation to improve local roads in this state. These property owners argue that, since they donated the right-of-way, built and paid for the roads and have kept up the maintenance until recently, it is now up to the motorists, who use and damage the roads, to make the necessary maintenance payments in the future. In some ways this is not an unreasonable demand. The average cost per mile of constructing these roads was in the neighborhood of $5,000, while the annual maintenance cost of local improved roads in this state for the past few years has averaged only about $200 per mile. It would seem that the motor vehicle whose damage requires this annual maintenance should be taxed to pay the major share of these very nominal maintenance charges.

While it is true that motorists in populous centers may consider it an injustice to be called upon to pay the maintenance bill on local roads in remote districts of the state, nevertheless it is quite apparent that the general prosperity and welfare of these populous communities depend in no small degree upon the corresponding prosperity of the rural communities in the state.

On the other hand, it can be said that without road communication the farm would be of little or no value and, therefore, the farmer is obligated, through very tangible benefits received, to pay a certain percentage of the local road-maintenance bill through a property tax.

Here is a big problem that can be solved only after a very careful and scientific study of the many factors involved. It is the writer's opinion that, with information secured from a comprehensive state-wide highway transport survey, a reasonable allocation of motor-vehicle funds to state and local roads can be worked out and, in addition, a fairly accurate determination can be made of the justifiable share of local road-maintenance cost, to be borne both by motor vehicles and local property. It is quite evident that maintenance funds derived from the motor vehicle cannot be justifiably allocated to each mile of road on the basis of traffic alone, for the simple reason that a road carrying no traffic at all requires a certain amount of maintenance to counteract various climatic effects.

State control essential

Along with the general trend of shifting increasing percentages of motor-vehicle funds from the state highway system to the local road system, some drastic engineering standards should be set up to insure that these diverted funds will be spent wisely and economically. Since the state highway departments are compelled to meet certain engineering standards and requirements set up by the U. S. Bureau of Public Roads before they are entitled to their share of the federal-aid funds, why is it not logical to require that local road departments meet definite engineering standards and requirements as outlined by the various state highway departments in order to qualify for receipt of their share of diverted motor-vehicle funds?

All plans and specifications for local road improvement should be submitted for the approval of the various state highway engineers, and state inspection should be provided on all local road-construction projects. In many counties and townships the plans and specifications are pitifully inadequate and the inspection on construction projects is a joke, or possibly it would be better to say a tragedy. This is no blanket indictment of all local road departments, for the writer is fully aware of the many instances where such departments are functioning just as efficiently as the average state highway organization. Unfortunately, these cases are limited.

There is little doubt but what local communities in many states are entitled to a greater percentage of motor-vehicle funds for road improvement and maintenance than they have been getting in the past. In North Carolina and Virginia the entire local road systems have been taken over by the state highway departments, thus insuring efficient expenditure of funds on their local roads. Pennsylvania has followed this policy on a more modest scale, adding at one time 20,000 miles of township roads to the state system. In states where most local roads are little more than unimproved trails this policy is no doubt best. However, in states like Indiana, where the improved county roads total more than 40,000 miles and where in many counties very efficient road departments have been developed, the wisdom of the state absorbing *all* local roads is highly debatable.

Based on a judgment of conditions existing in such states as Illinois, Ohio, Michigan, Wisconsin, Kentucky and Indiana, the writer contends that the state highway system should eventually absorb all roads on which a surface better than an ordinary untreated gravel or crushed-stone surfacing is needed. This would mean that the state highway engineers would have supervision of all roads requiring even, low-cost, black-top surfaces, as well as those requiring the higher types such as concrete, brick and high-type bituminous pavements. Thus the local communities would be left in control of only those roads that are of purely local significance. As an example, the Indiana state higway department, which

Low-type surfaces of natural soil are smoothed after every rain by dressing the surface with graders, planes, drags and other surfacing machines of many types.

now controls about 8,500 miles of road, would in a period of four or five years increase its total mileage to about 25,000 miles, leaving about 48,000 miles of local roads, of little or no through-county importance, in the control of the county road departments.

Due to familiarity with the situation here, the writer has used Indiana data quite freely in illustrating various points in this article. No doubt the situation in many other states corresponds quite closely to that existing in Indiana.

In an effort to determine the trend of gasoline-tax and motor-vehicle fee diversions from primary to secondary roads, the writer sent a questionnaire to each state highway department requesting merely percentage allocations of these funds in the years 1925, 1930 and 1933. It was thought that a percentage basis would be more satisfactory in illustrating this point. The accompanying table gives the results obtained from the states responding. The writer wishes to acknowledge the splendid cooperation received from various state highway officials. While in a few states all of these funds still are used exclusively on primary roads, it is quite evident that there is an increasing trend toward greater diversion of funds away from primary roads to secondary roads.

The writer's conclusions may be summarized as follows:

1. In general, secondary roads are entitled to a larger share of motor-vehicle fees and gasoline tax than they have been receiving.

2. The peak has been reached in improvement programs concentrated on main state highways.

3. We are now entering an era of unprecedented low-cost improvement of secondary roads.

4. There is a very appreciable trend in many states toward increased diversion of gasoline-tax and motor-vehicle fees from primary to secondary roads.

5. As rapidly as practicable, state highway departments should take over all roads on which a surfacing of higher type than an ordinary untreated gravel or crushed-stone surface is justifiable.

6. Comparable to the relationship existing between state highway departments and the U. S. Bureau of Public Roads, all plans and specifications for improvements of secondary roads should be submitted to the various state highway departments for approval, and state inspection should be provided on all such construction projects.

7. Based upon a scientific study of data secured from a comprehensive, state-wide highway transport survey, it should be possible to work out a fair division of gasoline and motor-vehicle revenue between primary and secondary roads and to determine with reasonable accuracy the proportions of secondary road costs that should be borne by motor vehicles and by local property.

* * *

With the considerable shifting of improvement to secondary roads come vital questions of the nature of improvement justified. Broad questions enter, dealing with secondary-traffic demand for road width, smoothness of surface and strength. Questions of relative economy of high-type and lower-type surfacing are offered. The whole problem of secondary road structure is opened for consideration. At present it is debatable and the presentation of opposed doctrines of engineering economics is as far as determination may go. On one side is the thesis that improvement should begin with very substantial surfacing, and on the other is the contention that the beginning should be with the least surfacing that will carry the traffic, to be built up as traffic increases.—EDITOR.

Paved Surfaces Unwarranted for Secondary Roads

A road should be designed for the traffic it is to carry, and there is seldom justification for building a heavy-traffic pavement for light traffic

By Prevost Hubbard
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THERE IS no universally accepted definition for secondary roads, but it is generally understood that the term secondary applies mainly to the traffic served by the road and that on such roads the traffic is relatively light as compared with highways carrying 1,500 or more vehicles per day, which may justify expensive high-type construction. A large percentage of roads on our primary system carries far less than this amount of traffic, and these should be classed as secondary highways. It is probable that over 90 per cent of all other hard-surfaced roads carry less than 1,200 vehicles per day, and the vast majority that may be classed as secondary carries less than 800 vehicles per day.

Even during the recent most prosperous period in this nation's history the general practice of constructing the heaviest-traffic types of pavements on our secondary roads, whenever enough money could be secured, was both wasteful and unsound. At the present time, if persisted in, it will seriously jeopardize the further systematic development of highway construction throughout the country. The truth of this situation has already impressed itself to such an extent on many of our leading highway organizations that thought and, to an increasing extent, practice is concentrating on the construction of low-cost types.

A road should be designed and built for the traffic that it is to carry, and there is seldom justification for building a heavy-traffic pavement for a secondary road unless it can be done at little or no greater cost than a suitable lighter-traffic type. This is just as applicable to bitumen as to brick

Typical Pennsylvania township road, 20,000 miles of which was added to the state system and is now being improved by the state as unemployment relief at a maximum cost of $6,000 a mile.

and cement. It is imperative that the funds available for secondary-road construction be used to improve as many miles as can be economically maintained.

If some traffic index, such as 1,500 vehicles per day, is taken as the division point between secondary and heavy-traffic highways, and it is realized that secondary roads carry traffic ranging from 100 to 1,500 vehicles per day (the vast majority, less than 800), with the expectation that for any given highway the increase in traffic will in most cases be gradual, the logical scheme of improvement is most certainly that of progressive stage construction. Progessive stage construction embodies the principle of first adopting the most economical type and design of highway for existing traffic needs, with a view to reinforcing the design and modifying the type only when increase in traffic warrants such changes. Prospective modifications should recognize as an asset any existing improvement and should utilize it to the maximum extent. In other words, the existing road should be added to and not torn up or replaced with an entirely new structure. Moreover, the extent of modification should be adjusted in successive stages with the increasing traffic.

For instance, if at 500 vehicles per day on an existing highway it becomes advisable to provide for a gradually increasing traffic, there is usually no excuse for jumping suddenly to a heavy-traffic type of construction. Thus, in the case of a surface-treated gravel road which, because of a slight deficiency in thickness, begins to require unjustifiably high maintenance under increasing traffic, there is seldom good excuse for constructing a portland cement concrete wearing course of 4-in. minimum allowable thickness; a brick wearing course of 3-in. thickness, or even a high-type bituminous wearing course of 2-in. thickness if a low-cost road-mix or plant-mix surface with the same available gravel aggregate can be constructed at a much reduced cost. In many instances the addition of a low-cost 2-in. wearing course to the existing road will successfully carry the increasing traffic for many years to come, with very moderate maintenance.

In progressive stage construction it is seldom necessary to increase the thickness of an existing highway structure more than 2 in. except in localized areas where subgrade conditions may be worse than average. In many cases no additional structural strength is needed. Wearing surfaces may be constructed of any desired thickness, ranging from a skin coat through bitumen-surface treatments up to 1 in., and penetration or mixed wearing courses and intermediate course of 3 in. or more.

On secondary roads there exists a tremendous field for further use of surface treatments. The service rendered by such treatments, intelligently applied to properly constructed or reconditioned low-cost roads, is really astonishing. For successful surface treatments there are three fundamental requirements that can usually be met with a little care and forethought. First, the road to be treated must possess sufficient structural strength at all seasons of the year to carry the traffic loads. Second, the surface should be uniform and of easy riding quality before treatment. Third, the road should be sufficiently wide to permit of good distribution of traffic.

With these three requirements satisfied, surface treatments with economical maintenance in many instances have successfully carried traffic up to 1,200 or more vehicles per day on sand-clay construction, and Missouri reports examples of successful maintenance of surface-treated earth roads carrying as high as 800 vehicles per day. Surface treatments on gravel and macadam roads frequently have proved both satisfactory and economical for a traffic of 2,000 or more vehicles per day.

It is extremely conservative to state that no more expensive type of improvement than surface treatment is justified on any secondary road carrying less than 800 vehicles per day, unless it is necessary to increase the structural strength of the road. Surface treatment of course adds little or nothing to structural strength, although it may tend to reduce loss of structural strength in rainy weather by waterproofing the surface and reducing absorption by the underlying road structure.

Unless surface treatment is applied to a bituminous road or one that has had a previous surface treatment, application of primer just prior to the construction of the bituminous carpet is highly desirable and, in many cases, is essential to satisfactory and economical results. Use of a high-grade primer, which has been developed during the past few years and is suitable for application to all non-bituminous surfaces, constitutes the most important recent advance in surface treatment work. Application of this primer, through complete absorption, hardens and consolidates the surface and insures firm anchorage of the carpet-building bitumen, which is next applied and covered with suitable mineral aggregate.

Mixed surfaces for strength

When it becomes necessary to add structural strength to an existing secondary road, it is frequently most economical to utilize it as a foundation for a 2- to 3-in. wearing course of low-cost road mix or plant mix, in which no preheating of the aggregate is required and the mixture is spread and compacted cold.

These low-cost mixtures add materially to the structural strength of the road and are capable of carrying economically the heaviest traffic coming under the classification of secondary roads. Owing to the fact that they are spread by road bladers or other mechanical devices, they produce surfaces of remarkably easy riding quality, equal to the best obtainable in any type of highway construction.

In certain instances the adoption of high-type wearing surfaces is justified on secondary roads, particularly when for certain times of the year they are subjected to very heavy traffic that would place them in the category of heavy-traffic roads if the average were not greatly reduced by the very light traffic that they carry during the remainder of the year. On large contracts where suitable local aggregate may be employed and machine spreaders and finishers are used, such wearing surfaces frequently cost so little more than the cold-laid mixtures as to be extremely economical. Bituminous macadam, the penetration type of construction, also in many cases proves economical as a wearing course for secondary roads.

The Pennsylvania road shown opposite after the state forces had graded and surfaced it with a 6-in. napped field-stone base and a 2-in. bituminous macadam top costing slightly less than $6,000 a mile.

Paved Surfaces Possible for Secondary Roads

Design changes and penetrated stone construction offer surfaces paved with portland cement concrete that fall well within the cost and traffic requirements of secondary roads

By E. M. Fleming
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CONCRETE ROADS, as commonly built on the main highways and the more important secondary roads, have demonstrated their service value and ultimate economy. It is only natural therefore that engineers should seek to modify accepted designs, so that the first cost will come within the limits ordinarily available in the secondary field. The major lines of development are as follows:

1. Single-track concrete of standard mix and cross-section design.
2. Revival of the cement-bound macadam or Hassam pavement.
3. Experiments with the sandwich type of cement-bound macadam as a resurface over old macadam or gravel.
4. The use of thinner sections of standard design.
5. The development of more economical methods of proportioning, mixing and placing standard concrete.

Single-track roads

In this type of construction a concrete slab of standard design but of a single-lane width is placed either in the center of the roadway or with its inside edge on the center line. Single-track concrete roads are not new. The first road, and one which is still in use, was built in 1912. To date, more than 3,200 miles has been built in 213 counties in 30 states. Several states and a number of counties have extensive mileages.

These roads have some apparent disadvantages when placed in heavily rolling or mountainous country, but, when used intelligently under all other conditions, they can be a highly satisfactory and economical method of securing a high-type pavement for little more than half the cost of the double-width slab.

Study has been given the frequency of passing on roads with volumes of traffic suitable for single track, and it has been found that for 500 vehicles per day, 98 per cent of the travel will be on the paved road. If only 300 vehicles per day use the road, this figure becomes about 99 per cent. This fact explains the satisfactory service that these roads have been giving.

While a certain mileage of single-track roads has been carrying traffic considerably in excess of 1,000 vehicles per day, an analysis of their capabilities indicates that they can be and in fact are being used to best advantage under the following conditions:

1. On roads on state and county systems that now carry traffic volumes of less than 500 vehicles per day, but which will obviously need widening when funds permit, because of traffic increases that can be definitely predicted. Also included in this class are roads now carrying higher traffic volumes but for which funds are not now available to construct a two-lane high-type pavement.
2. On roads on state or county systems that will probably develop traffic densities requiring widening, but the date of which is so far in the future that it cannot be definitely predicted.
3. On roads on county and township systems having present low traffic densities and upon which no appreciable increase in traffic is probable.

Sandwich-type cement-bound macadam constructed by spreading a layer of mortar between two layers of crushed stone and rolling until the mortar is squeezed into all the voids of the stone.

Cement-penetrated macadam

Before the mixed concrete road became so popular (that is, prior to about 1920) cement-bound macadam, or Hassam as it was then called, was rather extensively constructed. It enjoyed its greatest popularity in New York and in the New England states but was also used in nearly every section of the country.

Inspection of many of these old slabs, which are still in existence and serving traffic, shows that without question a remarkably durable concrete road can be obtained by this method. The main street of Lynn, Mass., was paved with 6 in. Hassam in 1907. It is now in almost perfect condition after carrying heavy business and through traffic for 25 years. A 6-in. slab on the Boston Post Road, 10 miles west of New Haven, Conn., is now in fair condition after carrying unusually heavy traffic for sixteen years.

Five experimental sections have been constructed this year. The first was built in July by the authorities of Morris County, N. J. This section is 6 in. thick and is on a road between Chatham and Myersville. Its success from a construction standpoint and its economy in comparison with other types that the county had been building led to the construction of another short section near Chatham.

Somerset County, N. J., has just completed a similar section on Rock Ave. near North Plainfield. Meanwhile, the Pennsylvania highway department built a section 5,290 ft. long with its own forces on Route 182 between Bath and Moorestown. This section was 18 ft. wide and had a 6-in. uniform section except for one stretch of 100 ft., where an 8-6-8 section was used. The New York highway department has just completed by contract a section 5,050 ft. long on the Newburgh-Vails Gate Road, just south of Newburgh, N. Y. It is essentially the same as the Pennsylvania section.

A coarse-graded stone ranging from about 1½ to 2½ in. is placed on the prepared subgrade. The stone is then rolled until a fairly uniform surface and degree of compaction are secured. It is then penetrated with a rather thin grout or mortar until the voids in the stone are filled. The surface is then rolled again, but with a lighter roller, after which surface irregularities are removed. A third and final rolling is

followed by hand-floating to remove projecting stones and other irregularities. This is in turn followed by hand-belting and then curing.

The cost of these experimental sections has been about $1 per square yard. Surface smoothness, while not as good as that obtained in mixed or standard concrete pavement, can be compared favorably with surfaces of other types built under somewhat similar conditions. When properly organized, progress should average about 1 mile per week.

Cement-bound macadam

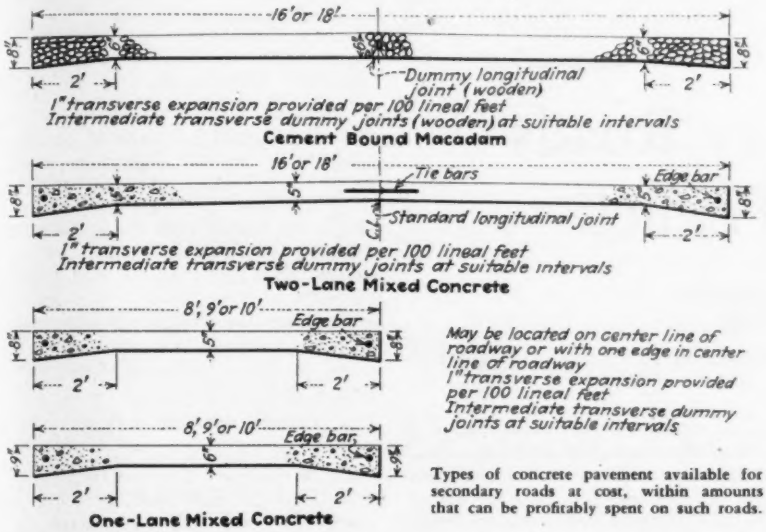
This type differs from the previous one in that it is usually built in thinner sections, is used as a resurface over old gravel or macadam roads, and mortar is placed between layers of stone and pressed into the voids by compaction.

Its greatest development so far has taken place in Germany, where several hundred miles of successful resurface have been built. In Germany and also in the experimental sections built in this country a special process portland cement has been used. This cement is composed of ordinary portland to which asphalt has been added. There is a marked retardation of the hardening of the resulting mortar, and it is claimed there is a lessening of its reaction to temperature and moisture changes. Its slow hardening and its ability to heal while undergoing this process, together with the support of the keyed coarse aggregate, enables traffic to use the surface as soon as the final finishing operation is completed. No curing is necessary.

In the sandwich method a layer of coarse aggregate is placed upon the prepared surface of the old roadway. This layer is rolled and is then covered with a spread of stiff mortar. Upon this is placed a second layer of coarse aggregate, whereupon the slab is thoroughly rolled to force the mortar into the voids of the aggregate. It is then ready for the final finishing operations.

Secondary road traffic in most cases will probably never approach that now being carried by our state highways, either in weight of vehicles or in numbers. Not only that, but trucks with solid tires are rapidly becoming a thing of the past.

There is no logical reason why the same thickness of cross-section should be used on a secondary road or even on a secondary state highway as is used on a main state highway. So far, relatively little discrimination has been used in designing concrete slabs for various conditions. First cost is now of paramount importance, and engineers are giving thought to this question with the result that important savings are being made, and at the same time a slab is secured which is adequate for its purpose.


16' or 18'
8"
2'
Dummy longitudinal joint (wooden)
1" transverse expansion provided per 100 lineal feet
Intermediate transverse dummy joints (wooden) at suitable intervals
Cement Bound Macadam
16' or 18'
Tie bars
Edge bar
5"
Standard longitudinal joint
1" transverse expansion provided per 100 lineal feet
Intermediate transverse dummy joints at suitable intervals
Two-Lane Mixed Concrete
8', 9' or 10'
Edge bar
May be located on center line of roadway or with one edge in center line of roadway
1" transverse expansion provided per 100 lineal feet
Intermediate transverse dummy joints at suitable intervals
6"
One-Lane Mixed Concrete

Types of concrete pavement available for secondary roads at cost, within amounts that can be profitably spent on such roads.

The Bates road test demonstrated that relatively light slabs could stand up under heavy traffic. A 9-5-9 section on this road took concentrated truck traffic on solid tires having a maximum wheel load of 13,000 lb. without failure. A 5-in. uniform section stood up under a 9,000-lb. wheel load, and two other 5-in. uniform sections showed no failures under an 8,000-lb. wheel load.

During the past four years the Portland Cement Association has conducted a survey of the performance of concrete on state highways under all kinds of traffic and climatic conditions. Detailed surveys were made of 6,600 miles of roads representing about 20,000 miles of concrete pavement. It has been shown clearly that a 9-6-9 concrete pavement is adequate for all except those roads that carry heavy truck traffic. If this cross-section is performing adequately on most state highways, why isn't a lighter cross-section advisable on secondary roads carrying much less traffic?

An added reason for these lighter cross-sections is the fact that pneumatic tires on trucks will allow a reduction of 20 to 25 per cent in the thickness of slab necessary for a given load over that required for the same load on solid tires.

Several states, particularly in the South, are using 8-6-8 sections on their main state highways. In one state secondary state roads have a 7½-6-7½ cross-section.

With these facts and many others in mind, there is no reason from an engineering standpoint why an 8-5-8 cross-section should not be satisfactory for secondary roads.

More economical methods

The cost of concrete pavements is also being reduced by speeding up production, by new devices for placing and

Truck mixer grouting a cement-penetration road with a pepper-box chute. These roads are a revival with improved equipment of the old Hassam construction used widely ten to twenty years ago.

finishing and by so proportioning ingredients that a workable concrete of the desired strength is secured with the greatest economy of materials.

Increased production per man is being secured by hitching two mixers in tandem. A batch is mixed for approximately half the mixing period in the first drum, then discharged into the second, where mixing is completed. For a 1-min. mix, maximum output is thus increased two-thirds, with an increase of only 10 per cent in personnel.

A conveyor that carried concrete from truck-mixers to its place in the pavement recently made possible an average production of 500 cu.yd. of concrete pavement per day in Massachusetts.

In Minnesota an experimental highway was built with similar equipment and a finishing machine provided with a longitudinal roller, to test the possibility of increasing the percentage of coarse aggregate.

The most outstanding recent development is a vibrator attached to the screed of a finishing machine. Mixes far too dry and stoney to be handled by ordinary methods flow into place like putty when struck off by such a screed. On experimental pavements in Texas, Missouri and Illinois it was found that higher percentages of coarse aggregate and drier mixes made possible a saving of approximately one sack of cement per cubic yard of concrete without exceeding the water-cement ratios commonly used in concrete pavements.

In Sheboygan County, Wis., concrete containing a high percentage of coarse aggregate was compacted with a 6-ton steamroller. Strengths were increased by reducing mixing water, and at the same time the cement factor was reduced.

Increased strengths or greater economy of materials has also resulted from the use of two and sometimes even three sizes of coarse aggregate, which are combined to produce a workable concrete with a low water-cement ratio.

In all these ways reduction in the cost of the concrete itself is making it more and more applicable to low-cost road construction.

When lower-cost concrete slabs are used on secondary roads, appreciable savings in the total cost of the road can be made by using standards of alignment, grade, drainage structures and other accessories that are in conformity with the class of the road.

Surface Secondary Roads for Secondary Traffic!

Economy of high-type pavement is questionable on secondary roads, but a full-width all-weather travel way is positively demanded

By A. R. Taylor
Engineer, Tarmac Department, Koppers Products Co., Pittsburgh, Pa.

IN THE PAST, the construction of paved surfaces has been, for the most part, confined to our main arterial or primary highways. As many of these highways carried through (state and inter-state) traffic, expensive standards of construction were followed. On such primary highways and on many highways having traffic counts of less than 1,500 vehicles per day the economy of high-cost paving is now considered very questionable.

It is necessary to connect main highways already paved with feeder roads, so that full benefit from our arterial highways may be obtained, and that new markets may be opened to our rural districts. Many of these secondary roads today, although unimproved, receive considerable traffic, frequently more than that carried by some of our so-called main arterial highways—hence the popular demand for wide, smooth-riding surfaces; and with this demand we are confronted with the problem of surfacing as many of these roads as possible. As there are more than 2,000,000 miles of these unsurfaced roads in the country, their surfacing presents a financial problem that can only be solved by the selection of economical types of construction.

Motor patrol renovating an old earth road taken over by state of North Carolina. Gradually the old narrow road is widened out to two-lane width, and profile is straightened and smoothed.

Traffic determines type

The surfacing of secondary roads should be designed in accordance to the traffic demands made upon the road.

Ordinarily secondary highways receive considerable less traffic than 2,000 vehicles per day, making it uneconomical to construct anything but a low-cost type of surfacing, unless abnormally heavy truck traffic makes a heavier type advisable.

Of the various types of low-cost surfaces we find surface treatments successfully carrying up to 100 to 1,500 vehicles per day, and mixed-in-place surfaces carrying as high as 2,000 vehicles per day. As the great majority of secondary roads carry considerably less than 1,000 vehicles per day, a vast field is opened to the low-cost surface treatment. This type of surface has the added advantage that it may be satisfactorily topped at a later date with a mixed-in-place or similar type of surface if traffic increases sufficiently to warrant the addition of a 2- or 3-in. surface.

Surface treatments

Macadam, gravel, top soil, sand-clay, chert and similar roads have been successfully surface-treated. Before applying, care is taken to see that the road is properly drained and the surfacing material of sufficient depth to carry the traffic load to which it will be subjected, and also that it is thoroughly compacted.

New roads of this type should be con-

structed to a minimum width of 18 or 20 ft., to reduce shoulder maintenance and make them safe for high-speed traffic. They are allowed to compact under traffic for a period of six months to develop any weak spots in the surface. These places are repaired and the road reshaped to proper cross-section, when necessary, before the application of the surface treatment.

Any new or untreated road surface should first be prime-coated. For best results it is essential that the prime-coat material not only penetrate deeply into the road surface but that it bind together the particles of aggregate in the penetrated surface. The prime coat is followed with a second application of heavier bitumen and covered with crushed aggregate.

A few years ago the addition of the covering material would have been the last step in finishing our surface-treatment work, but not so today. To adapt a surface-treated road to the requiremens of high-speed traffic, it has been found that by dragging the surface with a long-base drag we obtain thorough mixing of the bituminous material and aggregate and the removel of many slight depressions in the surface, thus assuring smoother-riding roads than heretofore obtainable.

Mixed-in-place surface

Where traffic exceeds 1,200 to 1,500 vehicles per day or where a thicker surface is desired, a mixed-in-place surface constructed to a depth of 1 to 3 in. will give satisfactory service. In the case of loose gravel or traffic-bound stone or slag roads, this type of construction is known as the graded-aggregate or mulch-treatment type. The loose aggregate is spread to a minimum depth of 1 in. If thinner than this, new aggregate is added to bring the loose depth of aggregate to 1 or 1½ in. It is then treated with a heavy grade of cold-application binder in two treatments, being mixed wih a blade grader and spread uniformly over the road surface, traffic being allowed to compact it thoroughly. A seal coat is added for certain gradations of aggregate. This type of construction has been used in many states, including Wisconsin, Michigan, Ohio and Pennsylvania.

The coarse-aggregate type consists of shaping the base properly, which, if untreated, receives a prime coat. Over this is spread about 2½ in. of crushed aggregate, to which is applied two applications of heavy cold binder that is mixed by blade graders, maintainers or long-base drags. The surface is then rolled and lightly choked with small chips, after which it is seal-coated and chipped, dragged and rolled. This type of surfacing has been used extensively throughout the Eastern and Middle-Western states.

These types of surfacing result in particularly smooth-riding sufaces and permit the use of local aggregates.

In the last two years there have been several machines developed to supplant the mixing of the aggregate and bituminous material on the surface of the road. These machines are designed to pick up the aggregate from a windrow on the road surface, mix it with binder, and discharge the mixture from the rear of the machine, leaving it in a windrow, from which it may be spread over the road surface by hand, blade graders or finishing machines. These machine road mixes, although permitting the use of slightly heavier binders than usually used for mixed-in-place construction, slightly increase the cost of the surface.

Conclusions

The types of bituminous surfaces described above make possible full-width paving with funds available. Their low cost does not, however, detract from their desirability, for, when properly constructed, they are unexcelled in their smooth-riding qualities and present safe surfaces for high-speed traffic of today.

Great strides are being made in the movement which calls for the paving of our secondary roads. Some states are constructing broken-stone wearing surfaces, or other types of aggregate surfacing, which later receive surface treatments or mixed-in-place surfaces. Such policies, if continued, will result in a vast network of low-cost surfaced roads throughout the country that will meet the demand of the traveling public for a more completely improved highway system.

* * *

Whatever the secondary road structure, the added mileage of secondary roads makes an increased maintenance draft of road income. This, coupled with increasing maintenance demands of main roads as they grow older, will consume constantly greater proportions of highway funds. This puts increasing pressure on maintenance engineering. Generally engineering thinking and research have been less progressive in maintenance than in construction. They need to be exercised more actively. Where can they be exercised to advantage in administration, budgeting, accounting, force organization, equipment management, work scheduling, materials investgiation, construction technique, methods of standardization, etc.? Consideration of the possibilities and the advantages that would accrue is vital.

—EDITOR.

Mounting Maintenance Costs Demand New Planning

More roads, older roads and cheaper roads are pyramiding maintenance costs to sums that call for a higher quality of engineering management than does new construction

By Leslie R. Ames
State Highway Engineer of North Carolina, Raleigh, N. C.

LET a maintenance organization forget a road for but a brief time and that organization will soon hear about it, and in no uncertain terms. To the man who lives in a house beside the road that particular road is the most important road in the world, and regardless of the importance of the road to the outside world the roadside dweller believes that he should have an all-weather road, preferably hard-surfaced, by his property.

This no doubt accounts in part at least for the ever-increasing mileage that is being added to state highway systems over the country. During the past year there has been added to state systems more than 26,000 miles.

As the mileage of improved roads increases and as the mileage of unimproved roads added to the state system increases so the cost of maintenance increases. This expenditure in some states now exceeds the total spent for new construction and is rapidly approaching this point in many states. This would be true of even more states were it not for the emergency construction funds recently appropriated by Congress.

The cost of maintaining roads is also mounting because improved roads are attaining a greater average age and because of the increased use of roads by vehicles that must be supplied continuous safe movement with a minimum of inconvenience. The fact that maintenance funds are being made to bear the cost of many items that should be charged elsewhere must be added to the legitimate causes for the ever-increasing maintenance cost.

It would appear that the day of issuing long-term bonds for road construction in the majority of states is over. As funds for construction get less there will be a growing tendency for state highway commissions to order the engineer to build a larger mileage of lower-type construction. This in fact has already taken place in some states,

and again this will also tend to increase maintenance costs as time passes.

Webster gives the following definition for the word *maintain:* "To hold or keep in any particular state or condition." If the only charges against maintenance were those that could be classed strictly in accordance with this definition, then the cost would be much lower. Many phases of road work have encroached on the "maintenance budget" when in reality they have no semblance to maintenance. When betterment or construction money is exhausted we naturally charge the necessary improvement to the maintenance budget. Such procedure is necessary because we must live within our income.

A striking example

The North Carolina General Assembly of 1931 turned over to the state highway commission the responsibility for the maintenance and construction of all the public roads in the state, to be financed exclusively by motor-vehicle and gasoline taxes. Accordingly, the budgets were established and, with the exception of a few betterment and construction projects, all funds for county roads were allotted to maintenance, if one could classify as maintenance the major portion of expenditures in counties that had been less progressive in their road programs.

The roads in these counties were not ready for maintenance, and the necessary work was widening roadway, straightening kinks, surfacing, bridging fords, removing boulders that were obstructing side ditches, removing rocks that protruded in the roadway, draining bottoms and other improvements *ad infinitum*. No doubt a similar method of handling such betterments is necessary in most maintenance organizations. However, this condition does not tend to present a true picture of the cost of maintenance.

The centralized control of all public roads has worked in this state and, while there may be many who do not agree on the efficacy of this plan, the fact remains, in the judgment of the writer, that the trend of the times is more and more toward centralization in both governmental and civil activities. Be that as it may, we have with us the problem of the increasing costs for maintenance; and while we in North Carolina do not claim that we have by any means solved the problem, yet our experience may be profitable to some other state that has this same problem thrust upon it.

By July 1, 1931, there had been expended approximately $200,000,000 on our state highway system. This construction work had been directly supervised through nine construction and maintenance district offices. This organization leaned very heavily on the side of construction due no doubt to the fact that into this work was being poured the largest amount of money, and due further to the fact that this work was much more spectacular. Maintenance was quite like the proverbial Topsy and, while the system was properly maintained, it is safe to say that it did not receive the careful supervision that it is now receiving.

So when we inherited some 46,000 miles of county highways to be added to 10,000 miles of state highways, we decided to change our set-up. The type of country served, the type and amount of traffic, the condition and amount of existing road mileage, and the funds available determined of necessity the organization required to carry on this work to be essentially a maintenance organization. The nucleus of the organization is the section foreman, who is assigned a section of road to care for. His work is augmented by floating forces of convicts and floating (large) tractors. The section system of maintenance has been more or less accepted as the best plan. However, more detailed study and accounting may reveal that this plan is not the most economical.

The state is now divided into five maintenance divisions, and there is set up in each division an office in charge of a division engineer, with an assistant and such clerical force as is necessary. Each one of the maintenance divisions in turn was divided by five, making 25 districts in the state. There is a district engineer with two or three assistants in charge of each district, together with one office clerk. The roads in each district are divided into sections, the state highway sections being from 40 to 60 miles in length and the county sections averaging 95 miles in length.

The centralized supervision took the place of 100 county offices handling the same work, and this effected a large saving *per se* to the taxpayer.

There was expended by the North Carolina state highway commission for straight maintenance and betterments during the fiscal year 1929-30 the sum of $4,500,000; for the year 1930-31 $4,000,000, and for the fiscal year after the reorganization the sum of $3,515,000. This fiscal year we will come within the amount of $2,500,000. There is a difference therefore of $2,000,000 in these expenditures in spite of the fact that each year the mileage on the state system has been expanded.

Through the valuable assistance of the U. S. Bureau of Public Roads a careful survey was made, prior to July 1, 1931, of the county road systems and expenditures for the preceding year. As near as could be determined there was expended by the counties $8,500,000 for maintenance and construction. The first year's operation under state control cost $6,380,000, and this fiscal year we will spend less than $5,000,000.

So today we are spending practically $5,500,000 less for maintenance and betterments of state and county highways than was expended during the fiscal year 1929-30. And yet I venture to make the assertion that the state highways are being maintained satisfactorily to serve the transportation needs of the state and, in at least 75 per cent of the counties, the county roads are being maintained better than ever before.

Bedding courses or cushions for modern brick roads are laid with a precision of thickness and smoothness that ensures a pavement surface with no variation exceeding 1/8 in. in 10 ft.

Practicable economy measures

It is not the intent of this article to prove that all states should take over the maintenance of county roads. I do submit that where the state highway system is well along toward completion, as was the case in North Carolina, it is fundamentally sound, as has been proved in this state. It is the purpose of this article to set forth certain well-defined principles that can be used to offset the ever-increasing charges of maintenance.

Perhaps the most important of all is

a proper administration set-up. Too often the wiles and wishes of the so-called politician are injected into the maintenance organization and, once in, the effect is quite similar to a cancerous growth. Roads can neither be properly constructed nor maintained by politics as the word is usually understood. Turn the engineer loose on the work free from political influences and then if he cannot do the job, get one who can. Then you will have an organization of workmen who need not be ashamed to look the taxpayer in the eyes and say, "You have received a return of 100 cents on every dollar that you have paid into the highway fund."

Progress in maintenance methods has been retarded partly because of the apparent lack of attractiveness of the work. There is nothing spectacular in maintenance to lure the engineer, and it has the appearance, on the surface at least, of being commonplace, monotonous and uninteresting. Location and construction on the other hand have been especially appealing to the young engineer. Added to these facts, the maintenance field in the majority of states has not afforded the opportunity for advancement. Many engineers who have started in the construction field have become proficient in that line and have stuck to it. While maintenance has attracted many efficient engineers, it has not attracted as many as has construction.

A close study of the two problems reveals that maintenance requires equally as much ingenuity and initiative as does construction. Maintenance has enough problems to vex and keep the interest of the smartest engineers. Especially is this true when we are forced to believe the truthfulness of an old definition of civil engineering: "obtaining from the expenditure of $1 what ordinarily is obtained from spending $2."

The improvement and perfection of maintenance tools and machines have lagged far behind the advance of construction machinery. With few exceptions, maintenance is performed today with practically the same type of equipment that was used ten or twenty years ago. Now that maintenance is taking and will take a more prominent part in the highway field, manufacturers and engineers will give more attention to the possibilities of improving maintenance machinery as well as improving maintenance methods.

The type and amount of traffic, the type of country and the funds available are matters over which we have very little control, but in a good many cases the existing road has been built by our own organization. If the road has been built in such a manner that the maintenance cost will be excessive, it is probably our own fault. We should have required as a qualification of the engineer who built the roads some previous experience in maintenance, because only from such experience could he know what effect many of the minor details will have on the cost of future maintenance. The importance of selecting material, locating ditches, determining the size of ditches, varying the thickness of surfacing material, preparing subgrade and many other details are learned only through maintenance experience. Therefore an engineer in charge of construction is much better fitted for his work if he has had maintenance experience before he is put in charge of construction work.

We have elaborate laboratories for testing materials that go into hard-surfaced roads, but we pay little attention to tests of material that goes into surfacing top soil, sand clay and natural-mix sand-clay-gravel roads. A more careful and detailed study of the selection of surfacing material for this lower-class road would pay dividends in lower maintenance costs. A more careful study in planning construction so as to hold down maintenance cost would be advantageous. A survey should be made to locate the best available material to be used in maintaining this lower-type road. Section foremen should be required to use this selected material in their maintenance work.

Budgeting and accounting

No sound business organization would attempt to do business without first establishing a budget of some type. This is also true of a sound highway-maintenance organization. Naturally the more complete the available accounting records, the more accurately the budget will be estimated.

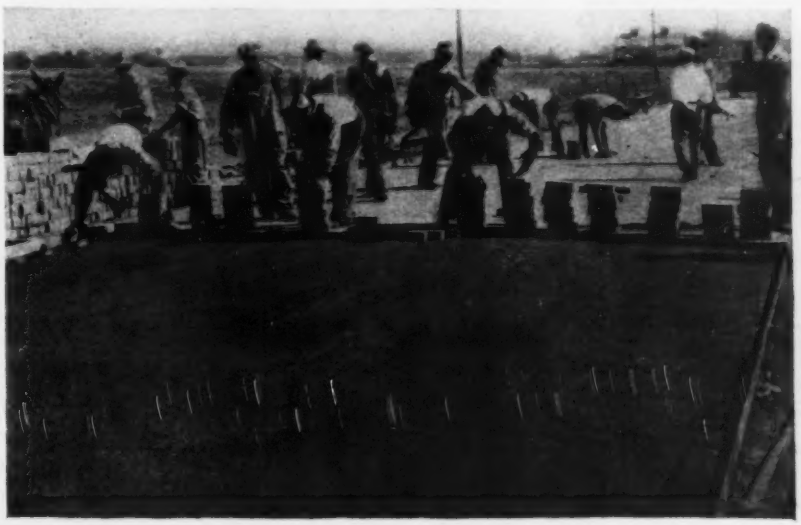
During this period when available funds are so low and demands are so great for maintenance that will give safety and convenience to traffic at the lowest possible cost, it is necessary that we give more attention to accounting. Only by careful study of the activities of our forces through detailed pictures presented from accounting can we save the situation. By no other means can we determine what is the most economical move to make from the standpoint of organization or type of equipment to employ. The task of getting accurate records on operations that are performed by men who have a minimum of understanding of cost-accounting is both tedious and gigantic, but it is possible and should by all means be accomplished. The accounting records should show the cost of maintenance of the different types of roads at different ages, should show the cost of the different phases of maintenance and should show this cost with different kinds of equipment and different kinds of organizations.

The accounting system should show all equipment of any consequence charged against the work on which it is employed at an adequate rental rate. By "adequate" is meant sufficient rent to take care of depreciation, obsolescence and repairs. This procedure adds to means for obtaining the true cost of any maintenance operation.

Adequate care of equipment such as inspecting, adjusting, greasing, cleaning, painting and housing is essential in order to get full value from equipment expenditures. What has been said about the importance of cost records of maintenance operations is equally as true when applied to equipment performance. The equipment department of the maintenance organization should be set up with detailed accounting records. Charges should be made for all expenditures for new equipment, parts, labor, shops, accounting, supervision, etc., and these charges should be balanced by credits obtained from equipment rent.

Money available for maintenance is decreasing because the revenue is falling off and because inroads are being made on highway funds by other departments of government that have lost a good part of their revenue. The situation will have to be met with a closer

Paving with brick has produced no equipment that can equal in speed and economy the skilled bricklayer served by helpers who pile the bricks ready to the layers' hands.



study of our problems and stricter planning of operations. A close study of accounting records and detailed planning of field operations appear to be the most strategic points for holding down the mounting cost of maintenance.

Centralized control of all (county and state) roads vested in the state highway commission will no doubt be more adaptable in some sections of the country than in other sections. It has worked out satisfactorily in North Carolina and has made possible, among other improvements, standardization of methods, coordination of efforts, equitable distribution of funds, uniform accounting, collective purchasing and more efficient utilization of equipment.

* * *

With the swing of attention to secondary roads, the main road is far from fading out of the investment picture. Main roads are not completed and, further, many miles of completed roads are aging to the point where reconstruction is necessary. This is a growing demand on road income. What is a rational technique of reconstruction? It demands determination, and as yet current practice is the only approach to determination. A study of this practice presents an impressive picture of the cost and skilled engineering involved.

Revamping the Paved Road an Increasing Obligation

Roads paved to an earlier traffic standard make increasing demands for widening and resurfacing and suggest that building for traffic ten or twenty years hence must be discarded

By O. W. Merrell
Director, Ohio Department of Highways, Columbus, Ohio

HARD-SURFACE highway construction in this country is comparatively a recent development, while the subsequent task of widening, revamping and reconstruction is only in its infancy. Stern realities have harshly awakened us from our Utopian dream of a permanent pavement, and we find ourselves face to face with the problem of salvaging pavements which were not designed with that in view.

Recent experiences with reconstruction have convinced us that the sooner we consider all of our highway improvements as stage-construction projects, the sooner we will have reached a rational or logical basis for the solution of our problem. These experiences have taught many things that have brought about revisions in the design of new construction, and the necessity for proper line and grade on original location should occupy a more important place in the minds of our engineers than in the past. Pavement construction of the future will be undoubtedly a continual building-up process, and each revamping, as time goes on, will result in a smoother and more substantial pavement.

Old 16-ft. brick pavement widened and resurfaced to two-lane width and two concrete lanes added, on Cleveland and Buffalo highway.

Width and alignment that are satisfactory at 25 miles an hour may present a dangerous condition at a speed of 50 miles. We cannot regulate the behavior of the motorist to any great degree, so we must put our highways in a condition that is in keeping with the times if we are to avoid serious loss of life and property. Popularity of motor travel and transportation has so far exceeded the estimate of its most enthusiastic proponents that we now face the situation wherein we have thousands of miles of pavements inadequate for present needs but possessing potential value that cannot be ignored.

Sound engineering, especially under present economic conditions, demands that we put forth every effort to devise ways and means to utilize this investment so that it will become an integral part of a new pavement designed to meet modern requirements and built at a minimum cost.

The motoring public demands a highway that is dustless, non-skid, safe, of sufficient width, smooth, of adequate line and grade and that provides uninterrupted service. Further than this it does not care of what material the highway is constructed. Therefore, when these demands have been met the problem of the engineer is to determine the design of pavement which will return to the motorist or taxpayer the best possible investment of his money.

With the demands of traffic now far exceeding the moneys available for highway improvement, and with our revenues largely coming from the roads as they are used, we must discard the idea of building highways adequate for an expected traffic of ten or twenty years hence. Rather we must build them to handle properly the present traffic, but in such manner that when heavier demands are made the widening and revamping to meet the situation can be done at a minimum of cost. This is purely a stage-construction proposition. With this in mind, the first thing in designing a pavement, either for new construction or reconstruction, is carefully to investigate the volume and nature of the traffic that a highway will be expected to carry. Such an investigation cannot be made satisfactorily in a haphazard manner.

Salvage survey

Ohio is one of the states which began a study of the flow of traffic on the state highway system some years ago in cooperation with the Bureau of Public Roads. This study has been continued each year, and detailed traffic data on each of our highways is available to all students of these problems. We have, by means of the data assembled, projected expectancy curves for traffic of ten years hence. It may be interesting to know that the results of

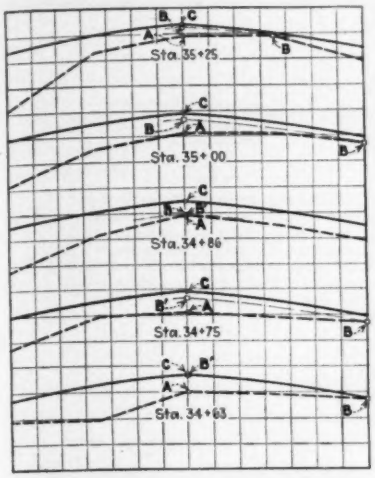


Fig. 1—Cross-sections of characteristic pavement surface, showing method of determining volume of surfacing material and developing a longitudinal profile.

our survey show that within the coming five-year period, traffic is expected to demand that we revamp between 35 and 40 per cent of the existing mileage on the Ohio state highway system.

The next step is to determine whether or not the existing pavement is competent in alignment and gradient to meet

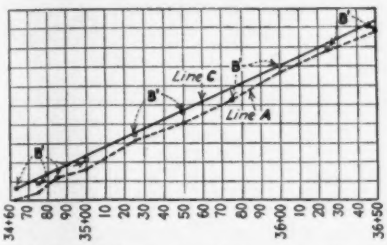
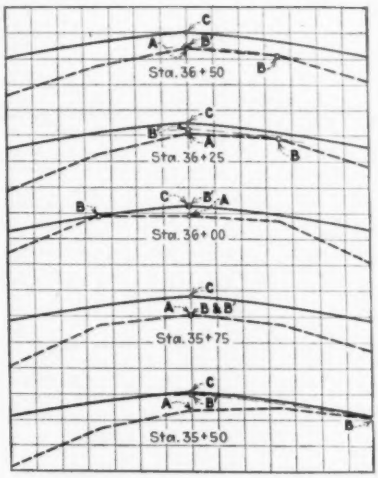


Fig. 2—Profile developed from cross-sections shown in Fig. 1.

the traffic needs expected in the nearer future. (In order that a proper perspective may be had, let me say here that this article is written, generally speaking, with a long-range view of the problem.) Any project under consideration that does not possess these necessary properties should be considered only for new construction, and any roadbed whose present condition and design is not subject to readjustment and revamping to fit a systematic plan of accommodating anticipated traffic should be discarded. If we made a bad guess on anticipated traffic a few years ago, we should admit that error now and start properly. Otherwise general-stage construction can never be rationalized.

When the above requirements have been satisfied, then a determination of the salvage value of the existing pavement should be made. To accomplish this, an investigation of old construction records should be made. A perusal of maintenance records, if available, is



often of value. The next step in this determination should be a physical survey as to thickness and unsound areas. Core tests of the existing surface will generally return the desired information. The next step is a preliminary engineering survey for the determination of approximate quantities of materials required for leveling processes. Considerable study can be given to this feature, and it may be possible to develop methods by instrumentation for recording degrees of roughness and for determining quantities of leveling material in some short-cut manner. Lastly, due consideration must be given to the effect which raising of the established grade by additional new surface construction may have on abutting property and intersecting thoroughfares.

Designing profile

Early in Ohio's program of revamping the paved road by widening and resurfacing it became apparent that some rational engineering procedure should be devised for fitting the new grade lines to the old construction and for the determination of actual quantities of leveling material required.

A method of procedure that has given simple, rapid and accurate solution is herewith described.

Prior to field work by a survey party, the surface of the old pavement is checked longitudinally at the center and quarter points with a mechanical surface tester that is adjusted to paint the surface of all high spots which exceed ½ in. in 18 ft.

The survey party establishes center-line stations at intervals not to exceed 25 ft., special attention being given to locating stations opposite summits of high areas, and changes in surface gradients. Nails or paint should be used to mark permanently the center-line stations, as these points are to be a series of temporary benchmarks for staking out the final grade.

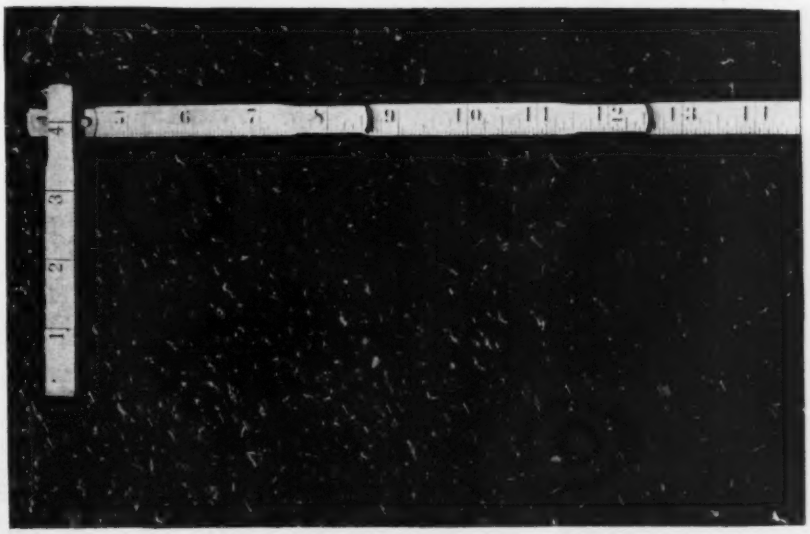
Five level cross-sections read to hundredths are taken at every station.

Cross-sections and center-line profile are plotted to a convenient vertical scale that can be graphically read to hundredths. An ideal working scale for cross-sections is 1 in. = 0.1 ft. vertical, and 1 in. = 1.0 ft. horizontal. The working scale for our profile depends entirely upon the gradients of the road.

Fig. 1 illustrates cross-sections of characteristic pavement surface, and Fig. 2 illustrates the developed profile and grade of same.

The design of the typical section for this construction specifies a minimum depth of resurface material. Therefore, for the purpose of designing a new profile and estimating quantities, the volume of material between the finished surface and minimum depth is a constant and need not be considered. The designer is concerned primarily with the amount of material necessary to shape the surface of the old road so as to conform to the finished surface of

Surface texture on the Cleveland and Buffalo highway after one year's use.



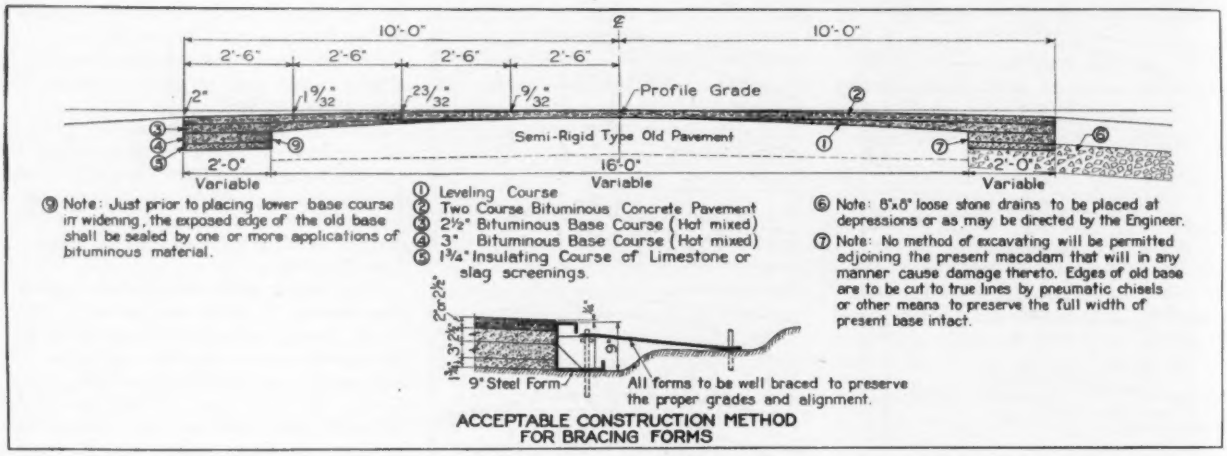

10'-0"
℄
10'-0"
2'-6"
2'-6"
2'-6"
2'-6"
2"
1 9/32"
23/32"
9/32"
Profile Grade
Semi-Rigid Type Old Pavement
2'-0"
Variable
16'-0"
Variable
2'-0"
Variable
⑨ Note: Just prior to placing lower base course in widening, the exposed edge of the old base shall be sealed by one or more applications of bituminous material.
① Leveling Course
② Two Course Bituminous Concrete Pavement
③ 2½" Bituminous Base Course (Hot mixed)
④ 3" Bituminous Base Course (Hot mixed)
⑤ 1¾" Insulating Course of Limestone or slag screenings.
⑥ Note: 8"x8" loose stone drains to be placed at depressions or as may be directed by the Engineer.
⑦ Note: No method of excavating will be permitted adjoining the present macadam that will in any manner cause damage thereto. Edges of old base are to be cut to true lines by pneumatic chisels or other means to preserve the full width of present base intact.
2"+2½"
1¾"+3"+2½"
9"
9" Steel Form
All forms to be well braced to preserve the proper grades and alignment.
ACCEPTABLE CONSTRUCTION METHOD FOR BRACING FORMS

Fig. 3—Typical section for reconstruction with black-base widening and bituminous-concrete resurfacing.

the designed section, and to a profile grade that will be acceptable.

A transparent celluloid templet is made having the same crown ordinates as the typical section and to the same scale as the cross-sections.

The templet is then placed upon the cross-section in a centered and level position so that some point on the templet touches some point on the cross-section at *B*. Point *B* is a control point and the point of minimum thickness of resurfacing material. As the control point may vary for every section, *B* is transferred relatively to *B'* at the center line. *B'* then can be plotted graphically on the profile from the cross-sections.

Points *B'* on the profile are a series of points to which a grade line must be fitted. The most economical grade, without removing any of the old metal, would be a grade line passing through all the ponts, but this would no doubt produce an unsatisfactory profile.

Straight-edges and irregular curves are used entirely in fitting a preliminary grade line *C*. This preliminary grade is plotted graphically upon the cross-section *C*, and the quantities are calculated.

From this point the designer must develop an acceptable and economical profile, keeping in mind that an appreciable reduction in quantities and cost can often be made by removing portions of the old metal in high areas.

The new grade should be pleasing and uniform in appearance. Rolling grades using short tangents are not objectionable, providing a smooth riding surface for high-speed traffic is obtained. Special care must be exercised to prevent short humps and hollows by controlling the length of vertical tangents and curves.

The success of reconstruction by resurfacing depends entirely on being able to reproduce in construction the designed profile grade.

Point *A* of the center line has been located on the old metal. The point *C* is the established profile center-line grade and also the bottom of the minimum surface thickness. The crown of the pavement is a constant.

A log is prepared for staking out the project, which gives readings at every station for the relative elevation between point *A* and the edge of the finished pavement. The edge of the pavement is then established in the field direct from point *A*, both in respect to elevation and line.

After the edge forms are set, a templet cut to the cross-section of the finished pavement should be used for a final checking sufficiently in advance of construction.

Following the procedure as outlined

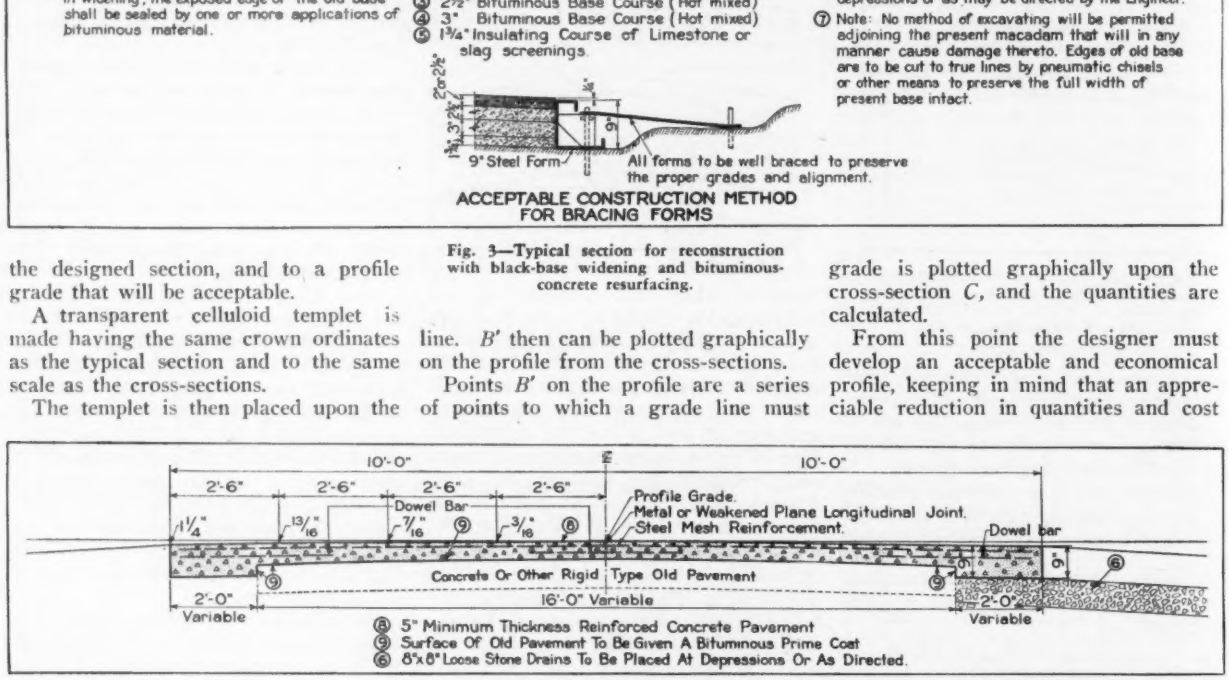


Fig. 4—Typical section for reconstruction with concrete widening and reinforced-concrete resurfacing.

Old 18-ft. concrete pavement widened and resurfaced to 20 ft. and one concrete lane added, on Cleveland and Youngstown road.

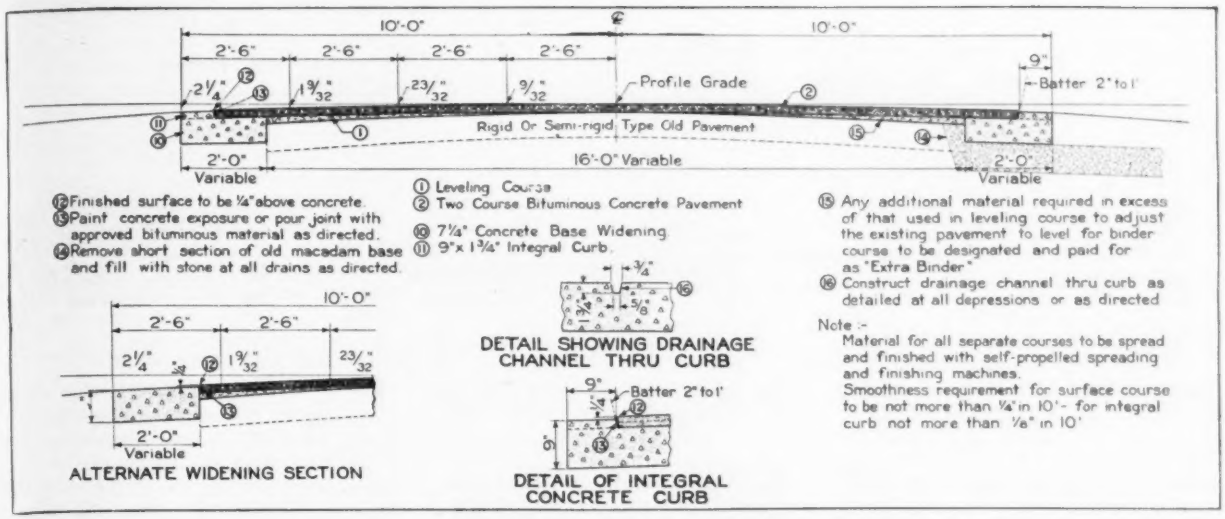

10'-0"
10'-0"
2'-6"
2'-6"
2'-6"
2'-6"
2¼"
1 3/32"
23/32"
9/32"
Profile Grade
9"
Batter 2" to 1'
Rigid Or Semi-rigid Type Old Pavement
2'-0" Variable
16'-0" Variable
2'-0" Variable
⑫ Finished surface to be ¼" above concrete.
⑬ Paint concrete exposure or pour joint with approved bituminous material as directed.
⑭ Remove short section of old macadam base and fill with stone at all drains as directed.
① Leveling Course
② Two Course Bituminous Concrete Pavement
⑩ 7¼" Concrete Base Widening
⑪ 9"x 1¾" Integral Curb.
⑮ Any additional material required in excess of that used in leveling course to adjust the existing pavement to level for binder course to be designated and paid for as "Extra Binder"
⑯ Construct drainage channel thru curb as detailed at all depressions or as directed
Note :-
Material for all separate courses to be spread and finished with self-propelled spreading and finishing machines.
Smoothness requirement for surface course to be not more than ¼" in 10'- for integral curb not more than ⅛" in 10'
10'-0"
2'-6"
2'-6"
2¼"
1 3/32"
23/32"
2'-0" Variable
ALTERNATE WIDENING SECTION
DETAIL SHOWING DRAINAGE CHANNEL THRU CURB
9"
Batter 2" to 1'
9"
DETAIL OF INTEGRAL CONCRETE CURB

Fig. 5—Typical section for reconstruction with concrete widening and bituminous-concrete resurfacing.

above gives reconstruction by resurfacing the same advantages as new construction, from a standpoint of predetermination of cost and results.

In our opinion, it is impossible to set from experience a hard and fast rule to be used in determining the type of material best suited for reconstruction. Traffic expectancy, proximity of materials, subgrade conditions, drainage, climatic conditions, nature of old pavements considered as bases, each must be considered in arriving at the ultimate design. These vary widely within the confines of our own state, and more widely throughout the nation. We believe that there is a place in revamping and reconstruction of highways for all of the now commonly known types of highway paving materials, and that proper selection must be made by the engineer after a detailed study of all conditions enumerated above. We further believe that there is a very fertile and, as yet, merely scratched field of research for all branches of the highway materials industry in the adaptation of each particular material to this problem, which in a short time will be our major enterprise.

For purposes of identification and reference we have made a classification of pavements as to base characteristics:

First, Flexible Type — Traffic-bound roads of gravel, crushed limestone, slag and other aggregates of untreated and bituminous-treated surfaces.

Second, Semi-Rigid Type — Waterbound macadam, bituminous macadam, sheet asphalt, bituminous concrete, natural rock asphalt and brick with flexible fillers or having gravel, limestone, slag or sandstone foundations.

Third, Rigid Types—Concrete and brick of monolithic construction or with grout filler.

Flexible types

There is now a large mileage of the flexible-type road having a base value of considerable proportions but inadequate for the traffic demands. Pavements under this classification are the sand clays of South Carolina, sand-asphalt mixes of California, oil mats of Kansas, gravel, stone and slag roads of Ohio, and many others of low-cost construction in every state. We are sensing a very popular demand for a large mileage of these low-cost, flexible and easily constructed roads, and we believe this type has a definite place in the big scheme of highway progress. These roadbeds in general are being salvaged and converted into higher-type pavements by the use of retreads, road-mixed and plant-mixed open-type bituminous mixtures.

Semi-rigid types

Ohio's system has many 12-to-18 ft. pavements of the semi-rigid type that are obsolete as to width, crown and surface contour but adequate in bearing power for present and anticipated legal axle loads. The greater mileage of pavements in this classification is two- or three-course macadam construction having aggregates of which 95 per cent would pass a 4-in. and be retained on a 2½-in. circular screen. Such construction is not adaptable to surface readjustment by scarifying, and surface irregularities can only be removed by the addition of suitable and stable leveling material of low cost.

In the leveling course careful consideration, along with the cost, has been given to the stability that the material and composition would guarantee for the support of the upper courses.

Waterbound macadam wedges were tried in an effort to keep the cost down, but this construction was abandoned as impractical. Next a modified penetration macadam was used with much better results, but it was difficult to obtain crown and uniform surface contour for the construction of succeeding courses. The last and most satisfactory

Completed bituminous wedge or leveling course for relaying old brick pavement.

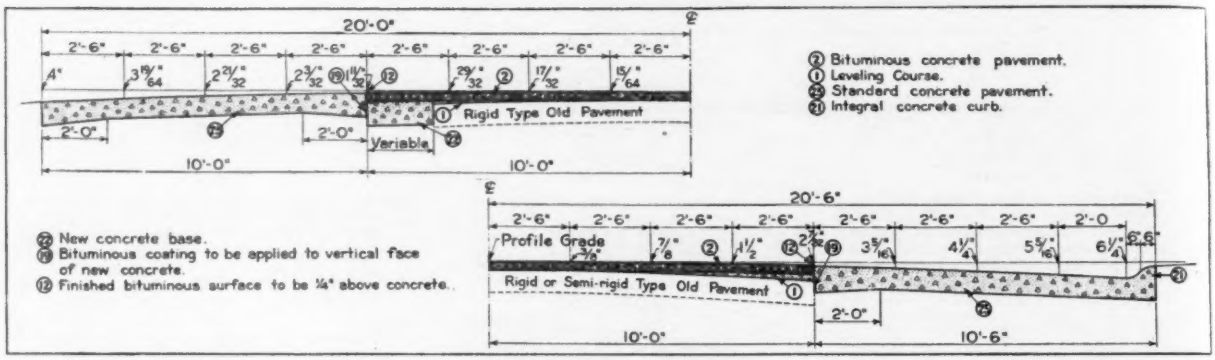
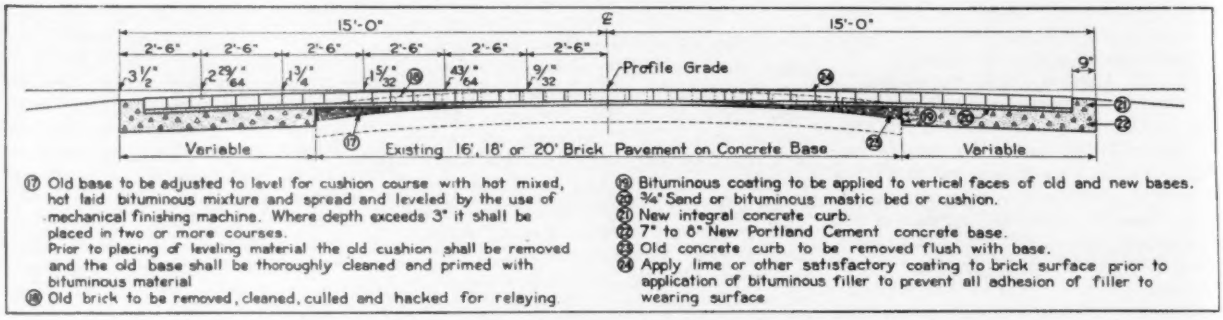


Fig. 6—Typical half-sections for widening and resurfacing and construction of additional lanes.

Fig. 7—Typical section for reconstruction of old brick pavement, by removal of brick and cushion, widening, leveling old base and relaying old brick.


15'-0"
15'-0"
2'-6"
2'-6"
2'-6"
2'-6"
2'-6"
2'-6"
3½"
2 29/64"
1¾"
1 5/32"
43/64"
9/32"
Profile Grade
9"
Variable
Existing 16', 18' or 20' Brick Pavement on Concrete Base
Variable
Old base to be adjusted to level for cushion course with hot mixed, hot laid bituminous mixture and spread and leveled by the use of mechanical finishing machine. Where depth exceeds 3" it shall be placed in two or more courses.
Prior to placing of leveling material the old cushion shall be removed and the old base shall be thoroughly cleaned and primed with bituminous material
Old brick to be removed, cleaned, culled and hacked for relaying
Bituminous coating to be applied to vertical faces of old and new bases.
¾" Sand or bituminous mastic bed or cushion.
New integral concrete curb.
7" to 8" New Portland Cement concrete base.
Old concrete curb to be removed flush with base.
Apply lime or other satisfactory coating to brick surface prior to application of bituminous filler to prevent all adhesion of filler to wearing surface

method was the use of either hot-mixed or cold-mixed (Amiesite type) bituminous concrete, placed and struck off with self-propelled finishing machines, using self-adjusting strike-off plates attached to the screed. This was proved to be the most successful method for obtaining the required stability and uniform surface, parallel to the finished crown and grade. In the past season all contracts covering such construction provided for the optional use of the last two materials and methods, and with few exceptions contractors elected to use the latter, as it insured them finished jobs that would meet the requirements for smoothness at lower cost.

A single-track concrete road built in Ohio in 1919, one of 3,300 miles of single-track paved secondary roads constructed since 1912 in 213 counties in 30 states.

Widening procedure for the macadam-type bases includes waterbound macadam construction, using the same sized aggregates as in the original construction in connection with new bituminous surfaces other than the hot-mixed, hot-laid types, and where projects do not provide for the use of self-propelled finishing machines supported by steel forms or adjacent concrete construction. This method of construction is confined mostly to highways showing no traffic forecast calling for additional widening within a ten- or twenty-year period.

Other widening procedure in the revamping of the semi-rigid-type pavements, on major routes where traffic demands it, might, during the life of the improvement, require the further widening by additional traffic lanes. In cases where present or future traffic might consist of a considerable percentage of heavy bus and freight transport service, a somewhat more stable design is required, and a hot-mixed, hot-laid asphaltic concrete or black base, using relatively large aggregate, is used for base-widening courses. In narrow widths and other places inaccessible for rolling, a novel use of a power tamper is made, and a much higher compression has been secured in this manner than by rolling. The typical section used for black-base widening and bituminous-concrete resurfacing is shown in Fig. 3.

Another widening procedure is used in a large number of projects on highways having similar service demands by widening them with concrete.

All the earlier concrete widening used to bring the width up to the standard of 20 ft. was constructed as pavement area, but a later method is the construction of the widening as base with integral and flush curbs of 9-in. width.

The typical section for reconstruction with concrete widening and bituminous-concrete resurfacing is shown in Fig. 5.

The surfacing material used with the last three types of widening (black base, concrete pavement or concrete base and curbs) consists of hot-mixed, hot-laid asphaltic concrete or cold-mixed, cold-laid, bituminous-concrete wearing course and binder course, both

courses spread and finished by mechanical self-propelled finishing machines. The spreading and finishing of the two courses, in addition to the leveling course, by finishing machines supported either by 9-in. steel forms as required for black base, or upon concrete edges, secures a remarkably smooth and uniform surface equal to that obtained with rigid types. Compositions for the bituminous wearing courses are so designed as to control the grading and proportions of the coarse aggregate and sand to give a non-skid surface of uniform and open texture that requires no seal coat and that will maintain its non-skid characteristics for a number of years. Surface-texture condition on the Cleveland and Buffalo Highway, U. S. Route 20, after one year's use, is illustrated by the accompanying view.

Where traffic requirements call for the addition of full-width traffic lanes, these are constructed by using standard concrete paving sections on either or both sides of the widened and resurfaced center lanes, with or without raised curbs as may be required.

A project showing the widening and resurfacing with asphaltic concrete of an old 16-ft. brick pavement, with two additional lanes added, and a project with old concrete pavement resurfaced with bituminous concrete and having one lane added, is illustrated in accompanying views. Typical half-sections showing lane-widening are shown in Fig. 6.

Revamping concrete

Probably the next largest mileage of highways now requiring revamping is of cement-concrete type. We believe that it is a sound principle to widen all such types with a like material. A serious study of the present pavement with regard to stability should be made before any decision is reached. If the pavement is badly broken into small areas, we have found it impracticable to use a surface course of bituminous or other non-rigid type, and we recommend only a resurfacing with reinforced concrete. In some urban areas the question of increased height of pavement grade may be a limiting factor, but these are only special instances, and we feel that the saving of the original investment is of greatest importance and overshadows a great many other considerations. The typical section for reconstruction with concrete widening and reinforced-concrete resurfacing is shown in Fig. 4. If a pavement has retained its solidarity but is of inadequate width and improper crown and shows conusiderable wear, it is resurfaced and the irregularities are removed with the more permanent types of bituminous-concrete mixtures. Either concrete pavement or concrete base with integral curb widening should be used the same as described in the widening of semi-rigid pavements. Brick also provides an excellent wearing surface for resurfacing this type of base, and its use should be determined by conditions such as the relative cost, service demanded, proximity of urban centers and other conditions pertinent to the particular project.

Revamping brick

Brick pavements of monolithic construction or those constructed with cement-grout filler and concrete bases have all the characteristics and require reconstruction as to widening and resurfacing in line with that for old concrete pavement, and considerable mileage of this type of brick surface on the major routes has been reconstructed in this manner.

In certain sections of the state many brick roads have been constructed in widths of 10 to 18 ft. that have given ten to twenty years' service. The base construction was generally of gravel or macadam with sand cushions.

Many of these pavements, in addition to being too narrow, were of high crown and extremely rough in surface. Such pavements generally have no salvage value except for use as foundations, and the very nature of their construction places them in the classification of semi-rigid bases, and the widening and resurfacing procedure is identical with that classification.

Some brick roads of more recent construction present another problem to meet in the revamping process that involves a resurfacing procedure somewhat different from those discussed.

Pavements of this type that have become prematurely rough and out of shape or whose crown designs are not suited for extension over the widening areas often have distinct salvage value in the brick as well as concrete foundation, and their reconstruction is handled in individual manner.

Reconstruction involves the removal of brick and cushion, constructing concrete-base widening strips of standard section and adjusting the old concrete base to the proper foundation contour and crown cross-section. This is done by using a wedge or leveling course of standard hot-mixed, hot-laid asphalt binder or some composition of smaller stone aggregate to fit special cases. The most important requirement in construction methods for placing this wedge course is that it shall be spread and finished with self-propelled finishing machines in a manner described earlier in this article. A typical section used for such construction is shown in Fig. 7, and the finished asphaltic-concrete wedge course for this project is illustrated in the accompanying view.

From our knowledge of the highways over the entire country we are convinced that the problems of this state are undoubtedly sectional. With the wealth of highway construction materials obtainable within its borders we have inherited our full share of pavement types. Our study and operations in this phase of reconstruction for the past three years have proved the desirability of a rational determination of real sound salvage value rather than the development of some universal resurfacing material, and for a period of years our projects for reconstruction will be more

* * *

Obviously, if highway development is to justify the claim for continued large expenditure, it must show profit or at least solvency as a transportation business. Can a convincing balance sheet be presented? A consideration of available information shows a dearth of specific data and a plethora of general assumptions and intangible values. There is little that can be proved and much that can be disputed. Attack on the highway business is very easy with such weak defenses. Depression has set the taxpaying public to an active casting up of accounts, and the highway transportation business is called upon for its figures. It is important to review first what figures it has to offer. —EDITOR.

Bituminous plant-mix laid down by spreader box behind truck is smoothed and spread by blade grader ready for rolling.

Road Costs and Revenues— How They Balance

An estimate based on general figures shows a saving of two billions a year due to highways already improved — Indeterminate values far exceed commensurate values

By P. M. Tebbs
Assistant Chief Engineer, Pennsylvania Department of Highways, Harrisburg, Pa.

DURING colonial days the best stock of the Caucasian race settled upon the land and laid the foundation of our present great nation. The remarkable development of our country can be attributed largely to the fact that this stock was established on the land, developed it and in turn developed with it.

Our industrial growth has attracted the most ambitious people to the cities where the tendency is to decay. Unless we can keep the best type of racial stock upon our land where it tends to build up, we may expect an inferior type to control the destinies of our country.

The best type of our race has advanced in modernization. It will not remain upon the land without enjoying the fruits of progress.

It is absolutely essential, therefore, that we continue the improvement of our highways, in accordance with present standards of development, to carry modern conveniences to the land, thus increasing its attractiveness. At present less than half of our farms are served by improved highways. It is true that the numerical majority of the people may be served by improved highways that connect the centers of population, but this is not enough. The roots of our civilization, which feed strength into the nation, lie not in the cities but in the land. To arrest the extension of highway development at this time would be to deny the fruits of progress to a large proportion of our established people.

Thus we approach the economic justification of present highway development. The total value of the service produced by improved highways cannot be estimated, but the value of the time saving in more rapid movement of traffic, conservation of motor power and reduction in maintenance and repair costs of transportation units can be measured.

State-system balance sheet

In a number of states there are good records of the comparable costs and revenues of improved roads. In Pennsylvania, for example, a comprehensive survey of transportation in 1924 showed that with 1,228,586 motor vehicles registered the 5,951 miles of improved state highways carried 1,832,665,000 passenger-car miles and 181,405,000 truck miles a year. Based upon savings as shown in Iowa State College of Agriculture and Mechanic Arts, *Highway Transportation Cost Bulletin 69,* it was estimated that the annual service value of the improved state highways was $54,900,000 for the 5,951 miles, or $9,220 per mile. At this time our average cost of improvement was relatively high due to the fact that the main roads, which required the most expensive types and heaviest grading, were being improved. The total annual charge consisting of the elements of first cost, economic life, general maintenance and salvage value was as a maximum approximately $4,300 per mile per year. It is evident, therefore, that the service value of the improved road over the unimproved road was more than double the average annual cost of the more expensive types.

This survey also disclosed the fact that more than 10 per cent of the travel on the principal routes originated in other states, and it was estimated that the expenditures of the occupants of these out-of-state cars increased the receipts of Pennsylvania business by $180,000,000 a year, an amount equal to 3½ times the computed direct annual service value of the highways at that time, but otherwise not considered in our economic calculations.

In the four years of the period 1928-32 the total estimated savings to motor-vehicle operators is more than $450,000,000, while in the same period the expenditures for state highways, including construction, maintenance and supervision, has been about $250,000,000.

In 1932 our state highway system has been increased to about 34,000 miles, of which more than 21,000 miles has been improved. There are about 1,750,000 motor vehicles in the state. The travel on improved state highways is about 5,000,000,000 vehicle miles annually.

A report in 1928 by the secretary of highways to Governor Fisher said, "The best information available indicates that the people of this state are saving over $115,000,000 a year, due to lower operating costs from the improvements made in highways on the state highway system and from the travel distance saved by relocations during the last few years." Since 1928 there has been each year additional mileage of improved highways, and each year a greater number of vehicle miles of travel on improved state highways.

It should be noted here that the average increased service value of improved roads over unimproved roads maintains a ratio of approximately 2 to 1 over expenditures for construction, maintenance and supervision.

Transportation surveys in other states similarly have shown great values of service in improved highways. A Connecticut survey from September, 1922, to September, 1923, reported, on 1,114 miles of the state trunk-highway system, 354,300,000 passenger-car miles and 59,700,000 truck miles. In this report the salvage value of the 1,114 miles, including bridges but exclusive of right-of-way, is estimated at approximately $23,000,000, and it is pointed out that if

Plant-mix bituminous highways are being extensively developed by using machines that pick up the aggregate from windrows and return it mixed to the roadway.

the service value of the improved roads were only 1c. per passenger-car mile and 3c. per truck mile, the annual total would be equivalent to about 23 per cent on the investment.

The importance of highways in promoting interstate communication is evidenced in the accompanying tabulation extracted from the U. S. Bureau of Public Roads' report of a survey of traffic on the federal-aid highway systems of eleven Western states.

TRAFFIC OF VEHICLES REGISTERED IN CENTRAL PLAINS STATES

Vehicles Registered in	Daily Vehicle-Miles in Arizona	California	Colorado	Nebraska	New Mexico	Wyoming	Total
Arkansas	2,100	1,200	2,000	900	2,400	200	8,800
Iowa	6,600	9,000	11,600	54,600	6,500	10,100	98,400
Kansas	8,700	8,200	52,000	40,400	15,800	6,900	132,000
Louisiana	1,000	1,600	1,000	0	1,600	200	5,400
Minnesota	4,900	8,200	3,600	10,900	4,100	7,200	38,900
Missouri	7,300	6,600	20,200	17,600	8,500	4,800	65,000
Montana	1,400	5,800	2,300	3,000	800	17,900	31,200
North Dakota	1,000	2,100	1,000	2,400	800	2,400	9,700
Oklahoma	10,400	6,200	19,900	5,800	23,500	3,400	69,200
South Dakota	1,700	2,900	2,600	16,700	2,000	13,400	39,300
Texas	27,700	14,000	25,500	4,900	115,500	3,800	191,400
Total	72,800	65,800	141,700	157,200	181,500	70,300	689,300

TRAFFIC OF VEHICLES REGISTERED IN NORTHEASTERN STATES

Delaware	0	400	0	0	0	200	600
District of Columbia	700	2,900	1,000	600	800	700	6,700
Indiana	5,500	6,200	6,300	4,200	5,300	3,600	31,100
Illinois	14,500	19,800	19,500	22,800	12,600	12,200	101,400
Maryland	700	1,200	700	300	400	200	3,500
Michigan	9,300	11,100	7,000	6,700	6,900	5,300	46,300
New Jersey	2,400	4,900	1,300	1,200	1,600	1,700	13,100
New York	6,600	14,800	5,600	4,500	6,100	5,000	42,600
Ohio	8,700	11,500	7,600	5,800	8,100	4,800	46,500
Pennsylvania	4,200	7,000	4,300	3,000	4,000	3,400	25,900
Wisconsin	3,500	6,200	3,300	5,500	2,800	4,500	25,800
Total	56,100	86,000	56,600	54,600	48,600	41,600	343,500

Balance sheets of single roads

The service value of individual roads and sections of roads has been computed and demonstrated to exceed the road costs. For example, the annual service value of the Lincoln Highway, U. S. Route 30, from Philadelphia to Pittsburgh, is approximately $7,000,000, or about $25,000 for each of its 274 miles. The 35-mile section of the same road from Philadelphia to Coatesville is credited with reducing traffic costs about $2,000,000 annually, about $55,000 a mile.

The Highway Research Board's committee on highway transportation has published results of investigations of annual costs and revenues for the very heavily traveled Boston Post Road between New Haven and Milford, Conn. The calculated annual cost per mile of this road was $9,445. This figure includes the following charges:

Interest on investment at 4 per cent	$33,518
Annual maintenance charge	5,898
Annuity for periodic maintenance and reconstruction	22,150
Engineering and administration on maintenance	324
Total annual road cost	$61,890
Annual cost per mile	9,445

The average daily traffic on this road was figured as 18,500 vehicles per day, or 6,750,000 vehicles per year, of which about 10 per cent, or 675,000, were commercial vehicles and 6,075,000 automobiles.

With the 2c. gas tax then in Connecticut, each passenger vehicle contributed 0.109c. per mile of travel. The annual traffic of 6,075,000 automobiles, therefore, produced through the gas tax $6,621.75 per mile of road.

The registration fee amounts to about 0.14c. per mile of travel, and so the 6,075,000 vehicles contributed $8,505 per mile of road.

The 675,000 commercial vehicles contributed 0.178c. per mile in gas tax and 0.5c. per mile in license fees, a total of $4,576.50 per mile of road.

From passenger cars and commercial vehicles the revenues, therefore, amounted to $19,703.25 per mile as compared with the annual road cost of $9,445.00 per mile.

The service value of the Boston Post Road, at 2c. per each passenger-car mile and 4c. for each truck mile, for each mile was $148,500. Results of the study of this highway show a remarkable yield of both revenues and service value compared to the annual cost and justify the original investment many times over.

Balance sheet for United States

There are more than 30,000,000 motor vehicles in the United States, of which about 10 per cent are commercial vehicles. The privately owned and operated passenger cars travel an average of about 7,000 miles a year each and the commercial vehicles about 10,000 miles a year each. The total of highway transportation is more than 200,000,000,000 vehicle-miles a year.

The problem of determining the correct saving per mile on improved roads over unimproved roads for passenger cars and commercial vehicles is a difficult one. *Bulletin No. 69* of the Iowa State College of Agriculture and Mechanic Arts, already referred to, gives this saving at 2½c. per mile for passenger cars and 5c. per mile for commercial vehicles. In a report of the joint transport survey under the United States Bureau of Public Roads and the highway department of California, the saving in average cost of operation on improved roads over that of operating on unimproved roads on the state highway system is computed as 2½c. per mile. The basis of these figures is not given, and it is stated that one-half of this saving is used since it was the wish to be conservative. It appears that time savings have not been taken into account, although proper values for time loss may account for 25 to 33 per cent of the savings. After a careful analysis of the cost of operating passenger cars and commercial vehicles over both improved and unimproved roads, taking int account fuel, lubrication, tires, maintenance and repair and time factors, it appears that a safe and conservative estimate of savings effected in the use of improved roads over unimproved roads is 2c. per mile for passenger cars and 4c. per mile for commercial vehicles.

Applying these savings to the total miles traveled per year on the public roads in the United States, we obtain a value of $4,980,000,000 per year as the saving, were this system all improved, as against the same system un-

In road-mix construction the tank-truck distributor has become the universal means of impregnating the surface layer of stone with asphalt or tar.

improved. The net annual saving or service value on the whole public road system of this country is, therefore, $1,660 per mile. Of the total public road mileage in this country, approximately 25 per cent is improved according to available reports. We know that the majority of this improved mileage is comprised of the trunk-line highways in the country. It is a safe and conservative estimate that the average annual cost for such highways would be about $3,000 per mile. Assuming that the remaining 75 per cent of the unimproved roads comprises the rural roads that can be improved at a cost of an approximate average of $6,000 per mile in accordance with the present proven practice in the state of Pennsylvania, the annual cost of such roads would be approximately $1,000 per mile. The average annual costs for improved mileage on the whole public roads system in this country, therefore, would be $1,500 per mile, or slightly less than the computed annual service value of $1,660 for every mile of public highway in the United States.

It will be borne in mind that the above conclusion is reached on the basis of present traffic, and it is unquestionably true that further highway improvement will develop additional traffic that will show even greater savings.

The present improved highway mileage carries between 40 and 45 per cent of the total highway traffic, and upon the basis of the total annual saving in operation costs given above it is evident that the saving is approximately $2,000,000,000 annually on the present improved highways. According to the report of U. S. Bureau of Public Roads in the year 1930, the total expenditure upon the public highways was $1,543,770,000. It is evident, therefore, that the annual saving upon the improved road mileage exceeded the total expenditure upon the public roads in this country during that year.

Of the total revenues used for the financing of all state highway work during 1930, 82.1 per cent was derived from motor-vehicle taxation, 10.8 per cent from federal aid and the remaining 7.1 per cent from property taxes. This indicates a healthy financial condition, since the user of the highway, who is most benefited, pays the greater percentage of the highway bills.

It is concluded, therefore, that improved highways result in financial savings which yield large profits to the entire nation; that for the general benefit of the people, the manufacturers and road users, this most active and progressive of our developments must continue without abatement; and that present revenues will generally permit this work to continue due to present price levels offsetting shrinkage in revenues.

* * *

Stability of income for highway development merges into the greater problem of maintaining and spreading construction income so as to preserve and stabilize the industry. In construction no problem has been discussed more widely in the last two years than the possibility of evening out the volume curve by advance planning and budgeting. Reviewing its opportunities in the highway field clears the outlook toward volume planning in all national, state and municipal public works activities throughout the country. —EDITOR.

Federal Aid Can Stabilize Highway Development

An appraisal of road mileages needing improvement and of the income available for the work indicates entire possibility of planned program that will stabilize roadbuilding

By Geo. B. Sowers
Consulting Engineer, Cleveland, Ohio

THE HIGHWAYS of the United States are now largely on a self-supporting basis. Their building and maintenance is no longer an infant industry, in need of aid and development. The great need today is the stabilization of the highway construction program through advance planning and budgeting.

The building and improving of roads during the past 30 years has made possible and produced the greatest industrial development that this country has ever known. The demand for improved highways by the motoring public has brough into existence the highway construction industry, now one of the ten largest industries of the country, an industry closely paralleling the automotive in size and importance. It is again the old story of the chicken and the egg—each is dependent upon the other, and many industries are dependent upon both.

During the last ten-year period it is conservatively estimated by the American Road Builders' Association that in the neighborhood of $14,000,000,000 has been spent for road purposes in this country alone. Roadbuilding has become a giant industry—not only providing the basis for a vast system of motor transportation, but occupying for itself a place of enormous importance in the industrial activity of the country. The amount of construction has been limited only by the rate at which the funds could be made available. The demand for highway improvements has been far in excess of the available revenue.

Mileage needing improvement

The need for further highway improvements can be realized when we consider the latest highway figures of

Australian cement-penetrated macadam-road surfacing is often given a concrete-road finish by applying a layer of mortar and belt-dressing the top.

the Bureau of Public Roads. Of the more than 3,000,000 miles of rural highways in the United States, only 730,000 miles has been improved with some kind of surfacing, and of this number only 145,000 miles has hard surfaces. There remains almost 2,300,000 miles of rural highways to be improved, in addition to a large mileage that must be rebuilt, widened and otherwise re-improved to meet present-day standards of safety and construction. These last items of betterments have been estimated to amount to more than 220,000 miles.

Much has been said and written during the last few years about "superhighways." The Bureau of Public Roads has recently given out figures showing that there is a total of only 3,790 miles of paved roads on the rural state highway systems more than two traffic lanes wide. Only little more than one-third of this mileage is four or more lanes wide. It is quite apparent that the system of superhighways is in its early infancy.

The need for improving highways during the next few years will greatly exceed the public's ability to finance the construction. If only one-fourth of the 75,000 miles of state roads now unimproved is paved, it will cost in the neighborhood of $500,000,000. The improving with gravel and low-type surfaces of the remaining three-fourths of this system will cost another $500,000,000. The rebuilding of the 145,000 miles of the state systems during the next ten years will probably cost $3,000,000,000 alone, making a total of $4,000,000,000 needed in addition to that required for improving the 2,200,000 miles of farm-to-market roads yet unimproved.

If only 1 per cent of the unimproved county and township roads is paved, the cost would be $550,000,000. If another 10 per cent is surfaced with gravel, it would add $1,760,000,000. Then if only one-third of the remaining mileage of unimproved county and township roads is graded, another sum of $1,800,000,000 would be needed, making a total of $4,110,000,000 that should be spent on the great unimproved county-township road system of the United States during the next few years.

This very conservative picture of highway needs during the next few years shows that the enormous sum of $8,110,000,000 should be spent in constructing and improving the highway systems of the United States, exclusive of the city pavements and maintenance.

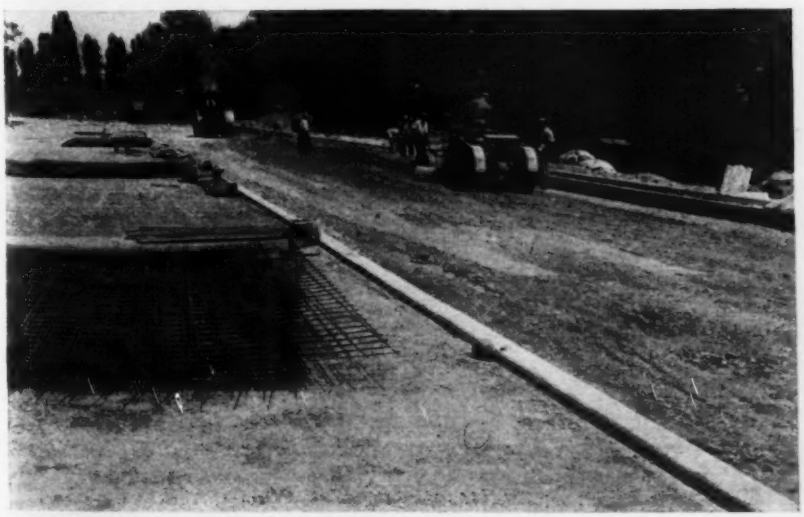
Such a program should probably be carried out within three to five years—but let us assume that it is spread over ten years. The amount needed for highway construction and improvement purposes each year for ten years would exceed $800,000,000.

Since there undoubtedly exists a tremendous demand for highway improvements, it is well that we examine the sources of highway revenue to determine whether the necessary funds will be the limiting factor in establishing a stabilized program.

Funds available

Turning again to statistics compiled by the Bureau of Public Roads, we find that during the period from 1922 to 1931, inclusive, the amount of money disbursed by and for the state highway departments was $7,451,573,108. During the period from 1923 to 1930, inclusive, the disbursements by counties and townships for local roads was $5,837,380,863. If to this latter figure could be added the local road disbursements for 1922 and 1931, the total amount expended would be about $7,000,000,000. In other words, the total disbursements for all road purposes in the United States over the past ten-year period were in the neighborhood of $14,000,000,000, exclusive of expenditures for our city pavements.

In building concrete base for asphalt pavement in Washington a raised or embossed strip of white cement mortar is constructed to mark traffic lanes.



Statistics show that very little of this great sum expended for highway improvements was provided through borrowing. Much has been made available directly by the users of the highways in gasoline taxes and license fees.

Ten years ago, in 1922, the highway users of the United States paid $152,047,823 in license fees and only $12,703,078 in gasoline taxes, a total of $164,750,901 paid for the use of highways and streets. In 1931 the license fees amounted to $344,337,654, and the amount collected from gasoline taxes had reached the sum of $536,397,458, making a total of $880,735,112 paid for the use of the highways and streets during 1931.

The total number of vehicles registered in 1922 was 12,238,375. In 1931 this had increased to 25,814,103 vehicles.

During the ten-year period from 1922 to 1931 the number of motor vehicles and the amount collected in license fees has approximately doubled. During the same period the revenue collected from gasoline taxes has more than quadrupled.

Figures compiled by the Bureau of Public Roads show that the motorists and highway users of the United States have paid only $5,279,927,956 during the ten-year period from 1922 to 1931, through license fees and gasoline taxes, toward the construction and maintenance of the highway system of the country, upon which it has been estimated that $14,000,000,000 has been expended.

During the next ten-year period the motorists will undoubtedly be called upon to carry almost the entire burden of highway construction and improving as well as maintenance, notwithstanding the fact that this investment in the industries of the country will be paying huge sums in general and special taxes.

When the construction of city pavements is added to the demand for rural highways, it will probably bring the need for highway construction and improving finances up to $1,000,000,000 a year for the next ten years.

Can the sources of revenue for highway construction be so regulated that each year the necessary one billion dollars will be available?

Regulation of revenue

The principal sources of revenue for highway construction are the gasoline tax and license fees collected by the various states and the federal aid that is provided from the general revenue of the government. The Bureau of Public Roads can and has prepared carefully worked out plans for federal aid. The execution of these plans depends upon the annual appropriation of Congress. The regularity in providing federal funds for highway purposes depends entirely upon each Congress.

The gasoline taxes and motor license fees are fixed by the several state legis-

latures. These legislatures are continually confronted with proposals to reduce the taxes and fees and to use the money for purposes other than highways.

The largest yearly sum provided by the highway users through license fees and gasoline taxes, for which figures are available, is the $880,735,112 paid during 1931.

If a reasonable increase in highway transportation is anticipated and none of the revenue provided by the motorists is diverted to other uses, it can probably be safely estimated that $1,000,000,000 will be paid each year in license fees and gasoline taxes for the improving and maintaining of highways.

The maintaining of the vast highway system of this country will require at least half of the billion dollars that the highway users may provide, which will leave only about $500,000,000 each year available for a highway construction and reconstruction program.

A strong public sentiment in favor of keeping highway revenue for highway purposes will go a long way in keeping the funds provided by the highway users reasonably constant in amount, if the highway users are fully and clearly informed upon the benefits that would accrue to them through a stabilization of the highway construction industry and the continuation of the highway improving program.

Many of the benefits to be derived through the stabilization of the highway construction programs are so obvious that it would hardly seem necessary to enumerate them. They are common to all lines of business and not peculiar to the highway industry.

Advance planning

If the highway construction needs in each state were set up in a ten-year program and consistently adhered to, the motoring public would profit greatly through a lowering of the cost of carrying out the program. Abnormally large or unusually small highway construction programs increase the cost of doing the work. Both foster inferior workmanship. A large yearly program calls labor from other lines of work, and the succeeding small program throws this labor back upon the market and many times upon charity.

No industry, even highway construction, can be economically run upon an uncertain and wildly fluctuating demand. During the year when little highway construction work is done the contractors are forced to do the work, often below actual cost, just to keep their organizations together. A host of failures and unpaid bills follow such a year. The contractors strive continually to reduce the cost of the work, even to sacrificing quality or not fully complying with the intent of the specifications. The next big construction year brings lack of competition, high prices, over-organization and over-equipping, and may result in careless work due to everyone's rushing the jobs.

Reasonably adhered to stabilized programs would place the highway contractor upon a firm production basis. He could assure his employees of continuous work, thereby building up a more efficient organization. His mechanical needs would be planned to get the most service from the equipment.

A stabilized highway construction program would be of the greatest help to the highway engineer. He would not build up large inexperienced organizations one year and disband them the next when the employees have become most efficient in their work. A hasty building up of the engineering organization always come with a big year's work when the least amount of time can be given to the preparation of the plans. More careful planning by thoroughly trained employees would result in lower construction costs and better improvements.

The lack of long-time highway construction programs places the material producer at a great disadvantage. If his plant is large enough for the maximum program, it must then work uneconomically on the smaller program. He is unable to accumulate stocks of material during the non-construction season. Too often the quality of his product suffers through overproduction, as well as underproduction. Here again business failures and unpaid bills follow a small construction program. Of course, labor again suffers through a widely fluctuating demand for material.

The manufacturer or producer of paving material, the employees and the job will all benefit through long-time planning of highway programs.

It is reasonable to expect that large sums of money will be spent during the next ten years for the construction and reconstruction of roads and streets. Experience has taught the highway engineer, the contractor and the public that the best results and the greatest economy come through long-time planning or stabilization of construction programs in industry. The highway industry is no exception. How then can the highway work be planned so as to, in some degree, stabilize the industry?

Begin with federal aid

Stabilization should begin with federal aid for highways. A carefully thought out program for a period of years prepared by the Bureau of Public Roads is probably as far as stabilization of federal aid can be carried. It is in the hands of each Congress as to how much money will be provided for highway programs. A sound program by the Bureau of Public Roads commands the greatest respect in Congress.

The amount of revenue to be derived by each state through gasoline tax and license fees can be predicted with reasonable certainty over a period of years. If these funds provided by the motorist are used equitably for the benefit of the motoring public, there is little likelihood that serious efforts would be made to change the rate of tax so as to modify a long-time construction, reconstruction and maintenance program. The greatest danger threatening stabilization of the state highway programs comes through the demands for the use of highway revenue for other than highway purposes. The public must be educated and informed upon the needs for highways and the place that the highway industry holds in the business of the community.

The necessity for reducing taxes upon real estate has made it almost impossible to provide motor highway funds through general taxation. Small sums will be provided where acute transportation ills exist.

In the rapidly growing cities traffic demands will make it necessary to provide funds for street improvements. In part, these improvements will be paid for through special benefit assessment. Where the financial condition of the city will permit, general corporation bonds for paving purposes may be issued to pay a portion of the cost of new pavements, but in the future a large portion of the cost for paving city streets must be derived from the funds provided by the motorists. More of the gasoline tax and license fee moneys must be allocated or spent within our cities.

Spreader boxes riding on wheels or skids are common equipment where crushed-stone surfaces are to be penetrated with cement grout or bitumen.

The stabilization of the highway industry will come when and only in the degree that the state and federal highway departments carefully prepare reasonable and sound programs for the construction, reconstruction and maintenance of the highway systems of the country.

Through education the public will accept long-time programs, and the legislature will conserve the highway funds for the carrying out of these programs. Advance planning will even out the volume curve in the field of paving improvements and bring about a stabilization of the highway industry.

* * *

Continued large expenditure on construction is manifest necessity and depletion of construction funds is under way. In what position is the construction industry, to offer battle for continued road construction and for the protection of highway income? Glossing the facts will not serve. Is construction a unified activity? Does it realize its function and know the value of its service? Has it facts which will compel a continued demand for its product? —EDITOR.

Construction Needs a Purge and Better Dietetics

The distress of construction goes deeper than current lack of work—Bad habits and questionable associates call for thoroughgoing elimination and a changed dietary if health is to be regained

By Henry H. Wilson
Chairman, Pennsylvania Construction Council, Harrisburg, Pa.

IN HIS advance comment upon my subject, the editor has said, "Construction is sick far beyond the lack of work. It lacks coordination and stability. It has to meet internal and external influences that are sapping its vitality." Assuredly, I am indebted to the editor for so descriptive and far-reaching a text.

Let us see how sick construction is for want of work. According to figures compiled by *Engineering News-Record*, the year 1928 was the banner one of the United States for total volume of all classes of construction. In 1931 building construction had shrunk to 36.6 per cent and road construction to 97 per cent of the 1928 volume. Figures for the first nine months of 1932 indicate that building construction declined to 16.3 per cent of 1928 volume, while roadbuilding reached 54.5 per cent of the corresponding months of 1928. As roadbuilding did not reach its peak volume until 1930, its dollar volume percentage in 1932, compared with 1930, is probably considerably less than 54.5 per cent. The foregoing figures outline conditions in the two largest branches of the construction industry. Other branches of engineering construction, such as streets, bridges, railroads, etc., have shrunk much more comparatively than has roadbuilding. Figures for the first ten months of 1932 indicate that, as compared with the same months for 1928, all construction, as measured by dollar volume, is at approximately one-fourth of the 1928 level.

The figures cited to show the decrease in the volume of business do not completely portray the market picture as it exists today. In those branches of construction where some semblance of market remains, competitive conditions are being rendered increasingly acute by an influx from other branches whose markets have collapsed. The increased production of equipment and materials and the tremendously increased productive capacity of the average constructing unit, resulting from the expansion of the past decade and mechanical progress, has further congested an industry already overcrowded before the event of the depression, in a ratio perhaps akin to the square of the decrease in the volume of work available.

Another factor adding to the prevailing distress has been the abnormal restriction of market through the nation-wide entry of political interests into the field of direct, or day-labor, engineering construction. Under the guise of emergency relief, but chiefly for political purposes, this day-labor wave has been accompanied by much hand-labor construction. The use of inferior local materials, as an accessory to this hand-labor movement, and other concomitants have reflected themselves in a further dislocation of the various units of the industry, including even the carriers, at a time when measures calculated to spread benefits over the entire fabric, rather than favored sections thereof, were demanded for the benefit of economic equilibrium.

In the face of all these difficulties, construction has been conspicuously lacking in ability to combat them. Organized chiefly in separate groups, incapable of reconciling their antagonisms and incapable of recognizing and coordinating their mutual interests, the industry, after reaching the summit of a boom market in 1928, has rapidly fallen into the abyss of a collapsed market where morale is far more lacking than in current business generally. In addition to and irrespective of the condition of its markets, construction has long been chronically ill from lack of coordination and from internal influences sapping its vitality.

In its general policy and adherence to the standard of competition for price only, construction remains essentially as it was in the dawn of history. As was said by a prominent construction thinker, "Like a leech this ethics-destroying attribute of price competition has fastened itself so firmly into our construction life that, astounding as it may seem politicians, bankers, labor and indeed most manufacturers, constructors, engineers and architects believe it to be correct." There are those who claim that, instead of progressing, construction has retrograded since the advent of corporate underwriting, because of an extension rather than constriction of opportunities to irresponsibles for embarking as its entrepreneurs. While many industries have developed new ideas to fit each discovery of science and have furnished vision and substance to forward constructive evolution, construction has continued to give thought

Part of the terminal loop of the Mount Vernon Memorial Highway, showing the double-light standards for the split roadway and the terminal service buildings

chiefly to methods incidental to immediate maintenance. There has been and still is a woeful paucity of effort to influence consciously the evolution of construction policies.

It is a sad commentary upon the conditions and practices in this industry that the chief incentive for many of its group organizations lies in the necessity for protection against the predatory tactics of other related groups rather than in the broader necessity of work for the common good. As in the ancient Greek states, the inability of construction groups to reconcile their purposes almost threatens eventually to destory the present method of conducting the business, as jealousies did a nation.

Shying at cost

By and large, construction in the past has devoted too much time and placed too much reliance on benefits anticipated from legislation. Its great problem is not regulation from without but regulation from within, and closer cooperation for mutual defense. Some elements of the industry, such as the public official, legislator, underwriter, equipment and materials man are either elements of other businesses or find their attitude so affected by relations with other businesses or influences that it must be admitted that this circumstance is a most serious obstacle lying in the path of reform. It seriously complicates their problem of changing practices for the benefit of construction.

The American Construction Council, organized in 1922, was an ambitious and highly deserving attempt to blaze the trail of internal regulation. The recently organized Construction League of the United States is another. It remains to be seen whether the industry has yet come to realize that unbiased scientific study and coordination of effort, working change from within rather than relying upon the discredited crutch of legal status, is the industry's distinct hope. In an industry where price competition is the accepted principle it is extremely difficult to find money to finance collective work. We glow at the thought of profits and grow cold at talk of appropriation for future benefits. Just now that state of mind is peculiarly emphasized by opportunisms and the need for self-preservation, particularly characteristic of depressions. Vast funds would be required to translate collective thinking into effective rules of action. Neither the industry nor the public has been willing to pay the money price. This is stated here not as a discouragement but as an incentive for the accumulation of added determination by those forward-looking spirits who have fostered cooperative work in the past.

Opportunism dominates

In order to escape the ascription of platitudinism to what has been said regarding the failure of elements of the industry to harmonize their viewpoints and reconcile their conflicting interests, it will be in order to examine specific cases.

Consider the wave of day labor that has been sweeping the country. The fact that governmental conduct of business is uniformly wasteful and extravagant is broadly shown and recognized. It follows therefore that, in the millions spent on day-labor and hand-labor construction in the past two years, the "benefits" of such procedure have reflected themselves in less jobs for engineers, constructors, equipment manufacturers, underwriters, material producers, bankers and carriers. Has the industry fully recognized this menace, magnified out of all usual proportion by its effect upon markets reduced to starvation levels? It has not. Constructors who have endeavored to convince other divisions of the business that here was a mutual, basic problem demanding aggressive joint action have frequently either been suspected of merely promoting a selfish purpose or else have been accorded half-hearted cooperation.

Let a particular machinery manufacturer be told that his policy of marketing machines by catapulting chauffeurs, shovel operators and whatnot as contractors into an already overcrowded business is damaging that business seriously, and the reception accorded will hardly be the same as that extended to a sunbeam on the Greenland coast.

Let some engineers be told that they should cast aside their superiority complex and recognize the qualified constructor as their co-equal in his special field and not afflict him with inspectors with a fatuous faith in the infallibility of plans and specifications, and you will receive a resonant alibi.

Let a constructor be told that his policy of reckless bidding and shopping among subcontractors, equipment and material producers is damaging the industry, and—well, you know the rest.

Let an architect be asked why he peddles bids, and he will doubtless tell you it is because so many other architects, and some engineers, do it.

Let an underwriter be told that the reckless extensions of credit, which have occurred in contract bonding, help to defeat the building up of responsibility and stability among the entrepreneurs of the industry, and you will receive another alibi.

Let a public official be told that he should help the sureties to solve this problem by taking a more vigorous attitude on the question of awards, and he is immediately haunted by fear of losing his job from unreasoning clamor.

Let the material interests be told that their policy of fostering legislation guaranteeing payment for materials, however recklessly sold, is inimical to the promotion of responsibility, and you are simply out of luck.

The answer in every case cited is opportunism and selfishness. A sense of responsibility for the common good is woefully lacking. Every division of the business keeps a full set of alibis constantly on tap. We simply have not yet become industry-minded to the extent required for solution of the problems that project themselves like sore thumbs, year after year. Each branch of the business is intoxicated with a sense of its rights and largely deaf to its obligations. Everybody is for reform provided his own ox is not gored. Until the industry develops such a spirit of compromise and teamwork as will permit the unscrambling of the vast assortment of alibis that now dam up progress, the outlook will continue to be discouraging.

Stop dreaming

Many construction units are still apparently basing their conduct upon the assumption that the bumper times of the "roaring twenties" will soon return and pull them out of the hole. It is to be doubted if we shall see such times again soon. It is expecting too much to

In modern mountain roadbuilding, tunnels are used without question where open cutting runs greater in cost. This tunnel is on the Skyline Drive on the Blue Ridge in Virginia.

look shortly for a repetition of circumstances created by the damming up of normal construction by the World War, the development of the automobile age and other factors. The purchasing power of the people has been reduced to a point where the increase of activity must be gradual, and the approach to a stationary level must also be evaluated.

Those who entertain hopes for a quick, drastic recovery might be reminded of the Iroquois chief, Hendrick, who, while visiting Sir William Johnson, spied a gold embroidered coat in the latter's wardrobe. "Brother," said Hendrick to Sir William, "I had a dream. I dreamed that you gave me your golden coat." "Since dreams come true," answered the wily Sir William, "I suppose I shall have to give you the coat." Later, Sir William, spoke to Hendrick about a tract of land that he wished to acquire. "Brother," said he, "I too have had a dream. I dreamed that in answer to my wish you gave me that piece of land." The old chief managed to reply calmly: "The land shall be yours brother, but from now on let us both stop dreaming."

Construction has had its gold embroidered coat and must cease dreaming and be content with plain homespun markets. It should not look to bumper days for relief but secure it from intensive and industrious application to the new problems presenting themselves, as well as to old problems still unsolved. It should exercise that patience, perseverence and frugality of the fathers that made America what it has been and can continue to be. It should attempt, as never before, to effect constantly increasing amelioration of debilitating practices and to establish coordination within its ranks. Change will create a new set of leaders. Those who have deflated their dreams and who maintain their cheer, courage, perspective and faith in the basic solidity of American institutions will be in a good position to be numbered among future leaders.

We have gained markedly in business confidence this year, and it seems reasonable to expect a steady, if slow, improvement in industry. This should bring some relief from overcrowed conditions. Those who sell short, as do most construction entities, always experience a high percentage of casualties in rising markets, and the latter should furnish further relief.

The writer sees no justification for the statement by a construction writer this year that "Irresponsible interests that operate on false credit during boom times have been eliminated from the field." Restriction of credit may have eliminated some, but it seems probable that entirely too many banks are still "in" the construction business and trusting to luck to get out. Survey of numerous bids and awards and general sales policies this year will reveal the fact that reckless and poorly financed operators have been flourishing with considerable vitality. Until construction is better integrated and conducted, our greatest hope for the elimination of such concerns lies in rising markets. They always accelerate the working of nature's law of survival of the fittest, under which the strong rise and the weak fall.

Deflation is helping

Lest this article be considered unduly pessimistic, let us consider that among the blessings of adversity we are discovering in these calamitous days is that unpleasant truths do not hurt as badly as those ignored or denied. We are turning from the idea of "prosperity around the corner," from the theory that our troubles are largely psychological and from a variety of anodynes with which we have been doping ourselves. We are becoming accustomed to the reality of looking unpleasant things in the face. As has been said: "In time we may even come to realize that we are not the richest, luckiest, happiest, most generous people that ever lived on this earth, that all our financiers are not wizards, our bankers pillars of society; our million-dollar executives, supermen; our petty politicians, astute statesmen. We are deflating more than commodity and security prices; we are deflating some of our national conceits." No longer need one be considered a pessimist for enunciating obvious but unpalatable truths that we have been trying to forget. "The habit of closing our senses to the ordures of our path, of singing ourselves to sleep with headline lullabies may be unsafe." Perhaps a little heart-searching coupled with a period of adversity when distressing truths cannot be evaded by the most robust will do us good.

Every problem of industry is a manifestation of human conduct. Such problems cannot be solved until the human and group factors underlying them are properly adjusted, disagreeable as the process may be. That is precisely the adjustment that construction needs. The industry may not after all be so inextricably tied to the profit motive as to defy scientific evolution.

It may yet be possible to discover a method by which even the price standard now dominating can be made the handmaiden of science. We might even discover a measure of relief by adopting the Swiss system of awarding on the average bid. Perhaps a too swift return to the prosperity of the "roaring twenties" would be a disaster eventually. What we need is to consolidate the gains and the lessons learned in the school of adversity, to eat and sleep with misfortune until we have lost all fear of it. Let us grip this ruinous situation into which we have dreamed ourselves until we have emptied its venom and can concentrate our thoughts on how to avoid a recurrence of such conditions as now largely destroy all hope of profit in the country's second largest industry. "Only our secret hopes, fears, prejudices, lusts and weaknesses are hurt by an open recognition of the truth, not life or industry itself, which remains enjoyable and adventurous." Let us recognize that the worst conditions in construction come from its own inharmonious entities. Through such a course we may discover the solid ground upon which a better construction industry of the future can be built.

Apparently the return of prosperity must be a matter of time, dependent upon world-wide forces. What construction will do with this prosperity, however, when it comes, depends upon every person and every unit thereof. It is their duty to face this problem honestly and courageously.

Viewing the future in its broad sense, it can fairly be said that construction's worst problem is not one of markets. Its burning problem yesterday was, and today is, regulation from within. In this respect "tomorrow" will be what it is made by the industry itself.

Bituminous surfaces of both road-mix and plant mix types depend largely on tractor-hauled blade graders to prepare the road for rolling.

Engineering News-Record

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Entering the New Year

Hope and doubt are conjoined in the minds of men as the new year opens. To all appearances, after experiencing an unprecedented disturbance from deflation and unemployment in 1932, the world is entering on a slow and stubborn uphill climb. Such a course preëminently calls for courage, initiative and persistence. The favoring condition is that financial conditions have definitely improved.. Money is now looking anxiously for employment, and its continued pressure to find profitable use may catch up with the progress of those readjustments that remain uncompleted. Under these circumstances construction activity, whose primary function in the ebb and flow of business is conceded, should have a hopeful outlook. Yet the immediate foresight is darker, if anything, than a year ago, due to the virtual failure of the Relief Act construction clauses and the inability of private enterprise to expand its operations in the face of decreasing buying power. Just as during 1932 the shrinking volume of construction reacted further to disturb general industry, the vicious spiral will continue downward if construction is further curtailed. But evidence of new courage to go ahead justifies the season's hope that reactivated construction may give the starting impulse to industry.

Public Bonds Regain Favor

Contrasting strongly with the conditions prevailing a year ago, the financial markets are now giving a favorable position to municipal bonds. When 1932 opened, the market for municipal securities had just about vanished, and those issues that could be sold yielded from 5½ to 6 per cent. The recent rise in prices has reduced the yield on issues classed as "legals" to the neighborhood of 4¼ per cent, and on many of the higher-grade bonds to but a trifle over 3 per cent. This is clear indication of an internal pressure acting to force investment funds out into the open. The drive against public expenditure, however, continues sufficiently strong to prevent cities from taking proper advantage of the favorable market conditions. Nevertheless, a receptivity on the part of the banks for municipal credit obligations has been an essential step in the tremendous task of reconstruction that lies ahead. That step has now been taken. Perhaps it will be followed shortly by a more general realization of the fact that idle funds mean idle men.

Salvaging Lost Values

One of the little-utilized opportunities for salvaging values lost in the drop of property earning power is found in rehabilitation of buildings and plant that are no longer able to hold their own against newer and better maintained competitors. It is an opportunity of great magnitude, and those rehabilitation efforts that have already been carried through give proof that sound financial planning can put them on a profitable basis. The immediate opportunities appear greatest in business and industrial properties, but the total of necessary and worth-while residential rehabilitation is doubtless greater. It is in some respects also the more important, for obsolescence in residential districts brings heavy losses to adjoining properties and, by laying a blight on large areas, also to the entire community. In the general public interest it is urgently desirable that a way be found to organize residential rehabilitation on a comprehensive scale, and thereby not only reclaim but also rebuild crumbling values.

Constructive Regulation

Only extreme partisans will find reason to criticize the findings of the special committee on bus and truck regulation of the U. S. Chamber of Commerce made public on Jan. 1. With commendable terseness the committee sets forth the major changes in regulation essential if our national transportation system is not to be disorganized. Many of the regulatory provisions of local character outlined by the committee have been put into effect in a few states and have found hearty support from the U. S. Supreme Court, but those that are of federal character or require joint state action have not been made effective. They should be set down as among the most important matters to be considered by the next Congress. For several years the country has watched the rapid growth of motor transport with an increasing realization that we cannot safely have one part of our transportation system closely regulated while another continues without like control. The history of the nation's experience with its railroads needs to be taken down off the shelf and reread. Before adequate regulation was instituted, competing water-transport lines were forced out of existence, competing rail lines were forced into bankruptcy by cut-throat rate structures, favored industries had rates rebated, labor was exploited, and in general the industry was demoralized at untold cost to the country. We must not court a repetition of this experience through continued neglect of motor-transport regulation.

Light From the Far West

Though long delayed, actual start on two of the Far West's large projects is most heartening at this season. The aggressiveness displayed by the Metropolitan Water District in getting the Colorado River aqueduct under way is encouraging. With the award of the seven-million-dollar San Jacinto tunnel contract, the District started the largest R.F.C. project. And immediately afterward it announced that work would be started at once on 33 miles of additional tunneling. While the wisdom of handling this twenty-million-dollar job by day labor will be questioned by many, the intent to get as much work as possible under way at the earliest moment is commendable. Along with the start of activity on the aqueduct comes the contract award for San Gabriel Dam No. 1, closing a long-chapter of mishaps and litigation. These projects added to four great dams already under construction—San Gabriel No. 2, Pine Canyon, El Capitan and Hoover—and coupled with two record-breaking bridges soon to span San Francisco waters present a bright picture of activity in the Far West.

The Challenge to Roadbuilding

EXPENDITURES for highway development cannot be curtailed. In a brief decade highway transportation has become an established business. A notable network of improved roads has been laid down, vehicles and roadways have been highly developed, and an assured income has been created by charges for the use of the road. A going transportation business of many billions of vehicle-miles a year has been built up. This progress is in danger of being turned into retrogression.

Unfortunately no comparable advance can be recorded in proper understanding of what the highway means to the community. Few people think of road expenditures in terms of transportation. The result is seen in frequent assertions that a moratorium in road improvement should be declared, and that income derived from the highway business should be applied to other state and federal functions—in the present emergency to the payment of doles. Dole payments have taken a hundred million out of 1932 road income, and hands are grasping for larger sums in the coming year.

What are the specific conditions that confront the highway transportation business? An answer is given in a notable group of articles written for this issue. They offer no ready formulas for solving the day's highway problems; they do no more than sketch a few outstanding elements of the problem. But they are pregnant with facts: They show that concerted attacks are depleting highway income, that adequate service and extension of the highway transportation business call for continued investment of all road earnings, that the industry is not prepared to act concertedly in defense of the highway business, that the business is unable to present a debit and credit balance, and that no real budgeting of expenditures has yet been attempted.

It is clear from this presentation of fact that highway transportation progress depends vitally on a stabilized road income and its continued investment in road improvement. Large mileages of road were built in an era of less intensive traffic and lighter loads, and are becoming obsolete in surface, width or bearing power. Modernization of these roads by widening and resurfacing is a current problem and will continue to be increasingly important. Further, a definite shifting of improvement from primary to secondary roads is going on, as a result of which the available highway income must be distributed over larger mileages. For like reasons, maintenance consumes an even greater share of highway income. Unless road income is conserved for road requirements, these services cannot be financed.

To the administration of roads as traffic-carrying plant and structures are being added pressing regulatory problems. These include the vital questions of traffic restriction or of providing separate roads for special traffic. Here state and interstate powers and action offer a supreme test of ability to bring about wise adjustments. Again, economic coordination of road and railway transport offers a huge problem of fact determination. Success in dealing with these accumulating transportation difficulties can be predicated only on stabilized highway income and management.

With pressing demands by the highway transportation business for all of its income to maintain and develop its business it now faces a diminishing income. To meet this distressful situation, the highway business is not prepared to present a balance sheet, nor a program of planned and budgeted road development; nor is it organized to present forcefully such evidence of the solvency of its business as it may possess. The thoughtful statement of these facts rounds out the impressive picture of the current highway situation presented in this issue. To the road user and administrator who views this picture carefully these articles sound a compelling challenge.

The effect should be to stir every fiber of the highway body to responsive concerted action. Because of the powerlessness of individual effort millions of dollars that had been given by road users to pay for an extended highway service were taken from roadbuilding budgets in 1932. If this process is to be checked, a plan and program for which to fight and a battle line embracing the whole highway industry are required. The conflict is so extended that nothing less comprehensive can determine the issue.

Unwarranted Indictment

WITH commendable promptness the American Engineering Council in a recent public statement indorsed the President's federal reorganization plan of Dec. 9. In doing so it expressed the majority opinion of its constituents, whose representatives on Council have for years urged the centralization of federal public-works activities. But in going farther and indicting the Corps of Engineers by declaring its river and harbor work to be inefficient the Council's statement reflected neither the conclusions of the Council nor the opinions of the engineering profession. On the contrary, besides doing grave injustice to the Corps, it injured the profession, in whose name the statement was issued.

Speaking by indirect rather than direct assertion the statement said, "The Corps has expended in excess of $1,540,000,000 for this work. What have we to show for this large expenditure?" In saying this the statement did not truly speak for the Council, for no action of the Council ever contained such an indictment. Still less did it speak for the engineering profession as a whole. The engineering profession lays no indictment against the Corps of Engineers. It may favor the reorganization of public works, as did this journal recently (*ENR*, Dec. 15, 1932, p. 731); it may disapprove the military system under which river and harbor work is now carried out; but it does not question the ability or efficiency of the army engineers. The profession is bound to disavow the Council's indictment.

The regrettable incident may, however, prove constructive if it leads to reform of the conditions that make such utterances possible. At present the Council is so loosely organized that statements made by its officials as representatives of the Council are not limited to views which that body has approved. More than one instance has occurred in recent years, and the profession in justice to itself cannot permit the practice to continue.

Undoubtedly the engineering profession needs a representative organization as spokesman in matters of national concern. American Engineering Council was created to meet that need, and in a decade of existence it has done much useful work. But if it is to realize fully its future opportunities as an effective instrumentality of professional opinion, it must find means to confine its public statements to the definitely expressed views of its constituents. When the Council speaks publicly it should speak only with the hearty support of the majority of the 60,000 engineers whom it represents.

NEWS OF THE WEEK

Contracts Signed for Large Bridge at New Orleans

FORMAL contracts for the construction of the New Orleans Public Belt Railroad bridge across the Mississippi River at New Orleans were signed Dec. 30 and checks covering the advances of the Reconstruction Finance Corporation for the project delivered. Surety bonds covering 100 per cent the amount of the four contracts were signed and the way opened for beginning of actual construction work.

The bridge may be considered to a substantial degree a product of the depression inasmuch as factors created by economic conditions have proven important in bringing 50 years of planning to realization. When the original permit for the construction of the bridge at a comparatively low level expired, objections from navigation interests resulted in a much higher clearance requirement, 135 ft. above high water instead of 117 ft. The greater elevation so increased the cost as to create a doubt as to ability to finance the structure, the estimate being close to $19,000,000, but the recent decline in construction costs brought the bid prices down to slightly less than $13,000,000.

The main span consists of a 790-ft. cantilever with two 530-ft. anchor arms. Two railroad tracks will occupy the space between trusses and the roadway will be carried on brackets.

Financing plan

Under the present financing plan the state, through the Louisiana Highway Commission, contributes $7,000,000 derived from the sale of gasoline-tax supported highway bonds (with toll free vehicular passage) and the balance comes from a Public Belt Railroad bond issue with mortgage lien on the structure. A contract for use by the Southern Pacific Lines insures revenue adequate to meet the terms of the mortgage.

At the formal signing of the contracts Marcus Walker, managing director New Orleans branch, Federal Reserve Bank presented for the Reconstruction Finance Corporation a check for $7,086,527 to the order of the Louisiana Highway Commission and one for $6,074,166 to the order of the Hibernia Bank and Trust Company, trustee for the Public Belt Railroad mortgage.

Contractors and engineers

Contracts for the work are as follows: Siems-Helmers, Inc., St. Paul, for substructure main bridge span, $3,083,185; American Bridge Co., for superstructure main bridge span, $2,618,670; MacDonald Engineering Co., Chicago, for substructure bridge approaches, $496,337; McClintic-Marshall Corp. (subsidiary of Bethlehem Steel Corp.), for superstructure of approaches, $3,226,789. These contracts were let in September, 1931.

Modjeski, Masters & Chase are consulting engineers on the project.

Ohio Court Upholds State Board in Order for Sewage Works

The right of the Ohio State Department of Health to issue orders requiring the construction of sewage disposal plants was upheld by the state supreme court in a decision rendered on Dec. 21. The case carried to the supreme court relates to the city of Van Wert where voters had refused to pass a bond issue for the construction of a sewage disposal plant which the state board of health had ordered built. In its decision the court said, "Current expenses must be secondary to levies to meet mandatory requirements, such as discharge of bonded indebtedness, interest thereon, and also compliance with orders of the state department of health issued under general state laws, which we hold to be mandatory."

On the grounds that the city lacked funds for the work, the city officials of Van Wert had refused to go ahead with the construction of the plant, estimated to cost from $200,000 to $250,000 after the voters had refused to pass the bond issue.

Action of the supreme court in the case of Van Wert has been watched with interest by the city of Columbus where the voters at the November election failed to pass a bond issue of $1,500,000 for the construction of a sewage disposal plant which the department had ordered built.

Transportation Coordination Measures Outlined by U.S. Chamber Committee

MEASURES to bring about a national coordination of the three main competing forms of transportation—rail, highway and water—in a way that will promote their proper natural development and at the same time adequately safeguard the public interest were put forward on Jan. 2 by a special committee of the Chamber of Commerce of the United States.

The findings of the Chamber committee were reached after several months of study and investigation of the present chaotic conditions in the transportation industry. The committee recommendations call for the elimination of any unfair advantages and inequitable taxation where they exist among the carriers and a system of regulation "which will permit each agency to function to its best advantage in the public interest in accordance with its inherent merits and without special privileges over other forms of transportation in which there is equal public interest."

The specific recommendations of the Committee are as follows:

1. That common carriers by water in domestic commerce should be required to file and adhere to rates, including port-to-port rates, in the manner now required by law with respect to railroad rates, and that such rates or modifications thereof should be subject to approval by the regulatory body, with reasonable differentials between rail and water rates where economically justified.

2. That neither rail nor water carriers should be permitted to establish rates to competitive points which are not adequately compensatory.

3. That all common carriers by water in domestic commerce should be required to obtain certificates of public convenience and necessity, and should thereafter be required to maintain an operating schedule, with the right to modify the amount of service in accordance with the reasonable demand. Operators of existing services should be allowed six months to establish scheduled services and qualify for certificates of public convenience and necessity.

4. That industrial carriers and owners or charterers of other vessels not common carries should be required to charge the established common carrier rates for cargo other than their own.

5. That government operation of water transportation is not in the public interest and that it be discontinued.

6. That there should be standard uniform requirements in all states as to allowable height, width and length of single and combined units, axle and wheel loads and speeds as recommended by the American Association of State Highway Officials.

7. That the enforcement of such uniform vehicle standards and safety regulations and the protection of the highway should be administered by the state in the exercise of its police powers.

8. That the construction and maintenance of general use highways, including costs of designated through highways within municipalities, limited to the average per mile cost of high-type state highways, should be paid by user taxes, with separate schedules for private passenger automobiles, buses and trucks as follows:

For private passenger automobiles (a) a registration fee graduated according to weight or horsepower and (b) a gasoline tax.

For buses and other vehicles carrying passengers for hire (a) a registration fee, (b) a mileage tax graduated according to seating capacity and (c) a gasoline tax.

For trucks (a) a registration fee, (b) a weight tax graduated so that it will increase more than directly with weight, or a ton-mile tax, and (c) a gasoline tax.

9. That gasoline taxes should not be so high as to encourage wholesale evasion and that the federal government should refrain from federal invasion of this field of taxation.

10. That states enter into reciprocal agreements for issuance of special licenses for commercial vehicles to cover states other than the home state at equitable rates to be determined by the conditions which prevail.

11. That all motor carriers for hire, whether in common carrier or contract service, be required to secure permit to operate, but that common and contract carriers in continuous operation during a stated peiod, and up to the time the law requiring permits is enacted, be granted such permits without further proceedings if their operatons are bona fide for the purpose of furnishing reasonably continuous service and if they meet the other requirements of such legislation.

12. That all motor carriers for hire, whether common or contract, be required to file and post their rates and adhere to them at all times, and that these rates shall be just and reasonable and shall not discriminate among different shippers, the proper regulatory body to have authority to pass upon complaints.

13. That all those using the highways for commercial purposes be required to establish their financial responsibility with respect to public liability and that common carriers be required to establish similar responsibility with respect to passengers and cargo.

14. That hours of service of operators of motor vehicles should be reasonably limited by public authority.

15. That proper regulatory bodies in each state be designated to enforce the provisions of the regulatory laws herein recommended and that these state bodies closely cooperate to the end that the various regulatory measures will be in harmony and will further sound treatment of highway transportation.

16. That in the public interest the same degree of regulation of interstate as of intrastate carriers should be applied and that, in regulation of highway transportation, the federal regulatory body should serve only as a court of last resort and that provision should be made for delegation of authority to boards of the state bodies in the states involved.

17. That Section 500 of the Transportation Act should not be construed as an expression by Congress of preference for rail or water transportation over highway transportation, or as a declaration by Congress of the relative importance to the public of the several kinds of transportation.

18. That, in reorganization of the federal government activities, agencies dealing with transportation be better coordinated and brought into closer working relationships.

The special committee on competing forms of transportation which prepared the report was composed of the following business men: David F. Edwards, chairman, president, Saco-Lowell Shops, Boston; A. J. Brosseau, president, Mack Trucks, Inc.; Joshua C. Chase, Chase and Co., Sanford, Fla.; L. W. Childress, president, Mississippi Valley Barge Line Co.; W. L. Clayton, president, Anderson, Clayton and Co., Houston, Texas; Eric A. Johnston, president, Brown-Johnston Co., Spokane, Wash.; W. P. Kenney, president, Great Northern Ry. Co.; Franklin D. Mooney, president, Atlantic, Gulf and West Indies S.S. Lines, New York City; Allison Owen, Diboll and Owen, Ltd., architects, New Orleans; J. J. Pelley, president, New York, New Haven and Hartford Railroad Co.; J. Howard Pew, president, Sun Oil Co.; C. O. Sherrill, vice-president, Kroger Grocery and Baking Co., Cincinnati; R. H. Sherwood, president, Central Indiana Coal Co., Indianapolis.

Some members of the committee dissented from a few of the recommendations.

Levee Contractor Restrained from Cutting Through Highway

The Louisiana Highway Commission recently was granted a temporary restraining order preventing the Trinity Farms Construction Co. from cutting a canal across the right-of-way of U. S. highway route No. 71 between Krotz Springs and Lebeau, La. The construction company is building Atchafalaya river basin spillway levees between Palmetto and Bayou Courtableau under U. S. Government contract and was alleged by the commission as planning to take their dredge boat across the highway right of way, which would necessitate the erection of a $50,000 bridge or abandonment of the road project.

The Trinity Farms Construction Company recently secured a federal court writ restraining the state supervisor of public accounts from collecting gasoline sales tax on 80,000 gallons of gasoline used by it on the federal project.

Ralph Modjeski Awarded Medal by State of Pennsylvania

Ralph Modjeski, engineer of the Philadelphia-Camden bridge, was honored on Jan. 4 when he was presented a gold medal and an engrossed scroll by the Governor of Pennsylvania in recognition of his services to the state.

The 1931 legislature provided $1,500 for the purpose of having the medal designed and struck off to honor Mr. Modjeski.

30-Hr. Week on Municipal Work Adopted in San Francisco

By the adoption of a relatively high wage scale, counteracted by establishing a 30-hour week, the San Francisco Board of Supervisors settled a question that will release $3,000,000 of municipal building construction for immediate bidding. The establishing of the wage scale will permit start of work on a new county jail, a cancer institute building and a psychopathic hospital.

The scale adopted is not in line with the recent 20 per cent reduction placed in effect by the Impartial Wage Board for private work or with the report to the Board of Supervisors by the Civil Service Commission. However, the scale set by the Impartial Wage Board is based on an 8-hour day, whereas the city's new scale on a 6-hour basis is in effect a 25 per cent reduction. Typical hourly scales adopted by the city Board of Supervisors are as follows: bricklayers, $1.375; carpenters, $1; structural ironworkers, $1.375; building laborers, $0.6875; painters, $1 and plasterers, $1.25.

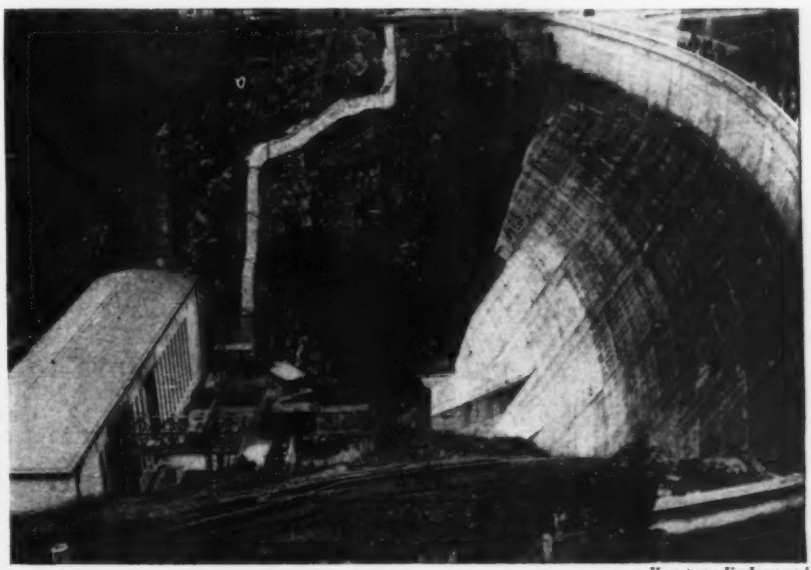
The net result of the action will be to reduce the daily wages paid to the workmen and to spread employment. The effect on building cost to the public is problematical. While the cost per labor-hour is increased, the amount of work done per unit labor-hour is likely to be increased, reducing to some extent the increase in cost of finished work.

The board reached its decision only after sharp discussion. Its final vote was 8 to 7.

Denver Speeds Work on Project to Bring Water from West Slope

As noted briefly last week, the Denver Municipal Water Commission has decided to install a 7-ft. steel conduit 15,860 ft. long in the west portion of the Moffat Tunnel pioneer bore which it has been leisurely lining since it acquired a lease on this 6-mile bore in 1929. The diameter of the finished tunnel is to be 10½ ft. and the work so far has been mainly east of the apex which is reported to be 90 per cent lined where necessary. By working continuously it is planned to complete the job sufficiently by early summer so as to run water through the tunnel in time for the 1933 irrigation season. This water, which will flow into South Boulder Creek thence into the South Platte River below Denver, will be exchanged with irrigation districts having rights prior to Denver for water stored above Denver.

Bids for the conduit are called for Jan. 10. The water commission forces will start in January enlarging the section and preparing it to receive the conduit and working on the Fraser River intake, tunnel and well at the west end. Action by the district resulted from a threatened water shortage due to low precipitation during the past two years.



Keystone-Underwood

LARGE POWER DAM IN GERMANY COMPLETE

One of the largest masonry dams built recently in Germany was dedicated on Dec. 2 after six years of work on the dam and power station. The dam is located on the Saale River between Saalfeld and Schleiz in Thuringia. It is for the development of hydroelectric power, the power plant being located across the gorge directly below the dam, as shown in the accompanying photograph, also for regulation of the Saale and Elbe rivers. The power station is served by an inclined railway extending from the top of the canyon wall to a terrace behind the station.

The dam is 200 ft. high, and forms a reservoir of 2,265 acre-ft. capacity.

Manager of Bridge District at Golden Gate Resigns

Alan MacDonald, general manager of the Golden Gate Bridge and Highway District, has resigned following action of the board of directors in reducing his salary by half and making the office a full-time position. During the past few weeks dissension within the board has occasioned censure by the San Francisco public and press over the resulting delay following the award of contracts. It is expected that the new manager will be named within two weeks.

Action oy the board was precipitated, according to reports, by the intimation that the Bank of America, which has purchased all the bonds to date, might withdraw its financial support unless there was more harmony in the administration. At the following meeting of the board the salary of the general manager was reduced from $25,000 to $12,000 and the position was declared to be full-time with the request that the manager maintain his office at the district's headquarters. The resignation of Mr. MacDonald followed. He is a member of the contracting firm of MacDonald and Kahn, San Francisco, which firm is a member of the Six Companies, Inc., builders of Hoover Dam. Heretofore the manager only has been required to serve part time. The increase in time demanded by the change to full time would not permit the proper attention to his other business affairs. Mr. MacDonald stated in his letter of resignation.

At present the question of surety bond for the contractors and details of the San Francisco approach route location are the matters delaying actual start of the work. Construction of the power-supply line is under way and one contractor has equipment on the ground.

Bids Called for New Bridge Over the Connecticut at Hartford

Bids for the construction of a new bridge over the Connecticut River at Hartford have been called for by the Connecticut River Bridge Commission, the bids to be opened Feb. 15. On the basis of the bids the commission will ask the state legislature for the funds necessary for completion of the bridge. The bids now called for are for a bridge located at a site not now favored by the commission as it is not authorized to proceed with its construction elsewhere. In its report to the General Assembly the commission will recommend the construction of the bridge at another site to make possible a saving estimated at $800,000.

East Denver Seeks an R.F.C. Loan to Obtain Irrigation Water

The Denver Municipal Irrigation Co. plans to apply to the Reconstruction Finance Corp. for a loan to finance the development of a water supply for irrigation purposes from wells in a 35,000-acre district east of the city of Denver. The possibility of developing the water at a reasonable cost is being studied.

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual meeting, Chicago, Feb. 21-24.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, Detroit, Mich., Jan. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention and road show, Detroit, Mich., Jan. 16-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, N. Y., Jan. 18-21.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-18.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, annual convention, Cincinnati, Ohio, Jan. 20-25.

AMERICAN TOLL BRIDGE ASSOCIATION, annual meeting, Camden, N. J., Jan. 16-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill., Jan. 24-26.

ASPHALT INSTITUTE, Asphalt Industry Conference, Detroit, Mich., Jan. 18.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, Detroit, Mich., Jan. 16-18.

CONSTRUCTION LEAGUE OF THE UNITED STATES, Detroit, Mich., Policy committee assembly, Jan. 21.

HIGHWAY AND BUILDING CONGRESS participated in by twenty national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Detroit, Mich., Jan. 17.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Ottawa, Ont., Feb. 7-8.

NATIONAL CRUSHED STONE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL READY MIXED CONCRETE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

NATIONAL SAND & GRAVEL ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

PORTLAND CEMENT ASSOCIATION, Detroit, Mich., Jan. 16-18.

THE NATIONAL RIVERS AND HARBORS CONGRESS is to be held in Washington, D. C., Jan. 17-18.

SAN DIEGO SECTION, American Society of Civil Engineers, has elected the following officers: president, R. Robinson Rowe; vice-president, Harold A. Noble; secretary, L. L. Mills.

THE SECOND ANNUAL WATERWORKS SCHOOL to be held under the direction of the College of Engineering at Rutgers University in cooperation with the South Jersey Association of Water Superintendents and of the New Jersey State Department of Health is to be held at the university Feb. 6-18. Information as to fees and the course can be obtained from Prof. H. N. Lendall, Rutgers University, New Brunswick, N. J.

MICHIGAN ENGINEERING SOCIETY will meet Feb. 9 and 10 in Lansing. It plans to devote a whole session to a discussion of R.F.C. self-liquidating loans. George B. Walbridge, John B. Hallihan and A. S. Douglass of the project board of the Michigan Trade Recovery Committee will be the principal speakers, the intent being to have national credit used for jobs instead of its being dissipated in unproductive relief. Other subjects scheduled include air conditioning, oil heating, sanitation work, drainage and surveying. A. Lederdink, Kalamazoo, is secretary.

THE NEW ENGLAND WATER WORKS ASSOCIATION second short course in waterworks management is to be given during the week of Jan. 23 in cooperation with the department of sanitary engineering of the Harvard Engineering School and the Massachusetts Institute of Technology. Two options are provided, one course being devoted to design and operation of waterworks and one to water purification and control of water quality. The course is limited to waterworks employees and members of the association or to applicants approved by a water commissioner, department heads of water companies or a state department of health. Information as to fees and courses may be obtained from the association, 715 Tremont Temple, Boston.

Brief News

THE RIGHT OF A CITY to extend its municipal services beyond its limits is being questioned in an injunction suit brought by the taxpayers of Seattle. The city had called for bids and was ready to award contracts on 17th Ave. N.E. extension of the city water system when the injunction suit was begun.

THE NEW LOUISVILLE & NASHVILLE R.R. BRIDGE across the Ohio River at Henderson, Ky., built at a cost of $4,000,000, was dedicated and formally opened on Dec. 31. W. H. Courtenay, chief engineer, threw the switch on the Indiana approach and a special train carrying railroad officials backed across the bridge to meet a regular train from the other side.

FURTHER POSTPONEMENT OF CONSTRUCTION by the Western Pacific Railroad of its projected line between San Francisco and Nilew, Calif., has been authorized by the Interstate Commerce Commission. The project was approved in January, 1931, but on the road's petition the date for commencing construction was postponed first to Jan. 1 this year and now to Jan. 1, 1934.

CONSTRUCTION OF A 6-MILE BOULEVARD along the line of the old Erie Canal from the Buffalo city line to the Tonawanda city line is projected by the board of supervisors of Erie County, N. Y. As a preliminary the board has approved the transfer of control of the abandoned canal land from the county highway department to the Erie County park department. Construction of the boulevard is being considered as part of the 1933 emergency relief program, and an appropriation of $700,000 is under consideration.

Personal

E. D. RUSSELL, Willard, Ohio, has been appointed superintendent of maintenance of the state highways in Huron County for the Ohio State Highway Department.

R. B. SHAW has been appointed county engineer of Lincoln county, Davenport, Wash., to succeed WALTER HIGGINS. Mr. Shaw has served in the engineering department of both Lincoln and Stevens counties.

C. E. McKEE has been appointed chief engineer in charge of maintenance, Ohio state highway department, and FRED L. BEICHELE has been appointed chief engineer of division 11 with headquarters at New Philadelphia, Ohio, to succeed McKee.

Obituary

LESTER L. MEYER, civil engineer for the Los Angeles, Calif., Bureau of Power and Light, died Dec. 27 following an attack of pneumonia. Mr. Meyer became associated with the municipal bureau immediately after he received his degree at the University of California in 1925 and specialized in hydraulic engineering.

EDGAR WILLIAMSON, superintendent of the General Dredging Contractors, Ltd., for the province of Quebec, died at his home in Montreal on Dec. 25, age 45 years.

Mr. Williamson was a native of Norway. For 15 years he was in the employ of the Puget Sound Bridge & Dredging Co. on the Pacific Coast and in Texas and in 1927 he came to Quebec in charge of dredging at Wolfe's Cove and since that time has been in charge of dredging operations in the St. Lawrence ship channel and in the harbors along the river.

WARREN A. CLEGG, plant superintendent Henry Bickel Co., construction engineers, Louisville, Ky., died of pneumonia on Dec. 23, at Louisville. Mr. Clegg was 67 years of age. He had been with the company more than 20 years.

ALBERT HOTCHKISS CHANDLER, assistant engineer, topographical bureau, Borough of Queens, New York City, died on Dec. 21 following a few days illness of pneumonia. Mr. Chandler was born in Buffalo, N. Y. in 1872 and graduated from Cornell University in the class of 1902 as a civil engineer. Previous to entering Cornell, Mr. Chandler was engaged in electrical work and during the Spanish-American war served in the navy as an electrician. Shortly after graduation he entered the employ of New York City on subway work and soon after transferred to the topographical bureau of Queens.

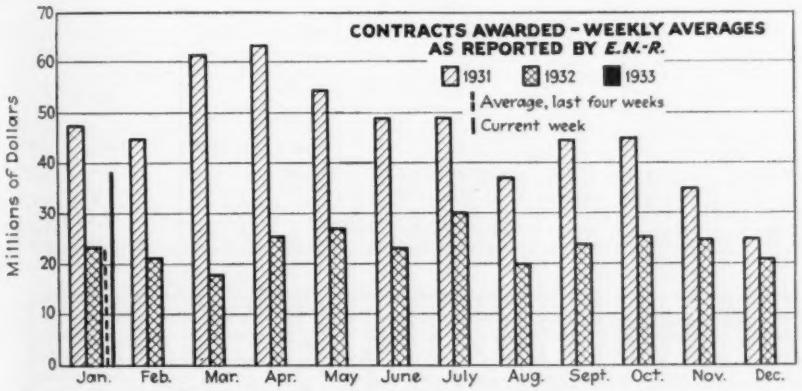
ALBERT N. CONNETT, former chief engineer and managing director of J. G. White & Co., Ltd., of London and a director of the J. G. White Engineering Co., died in New York City on Jan. 1, age 73 years. Mr. Connett was a graduate in civil engineering from Rensselaer Polytechnic Institute, class of 1880, and early turned his attention to street railway work, designing the first successful scheme for operating street cars from an underground power conductor. In 1896 Mr. Connett went to Paris as chief engineer of the Thompson-Houston Co., an affiliate of the General Electric Co., in which position he supervised the design and construction of numerous street railway lines in France.

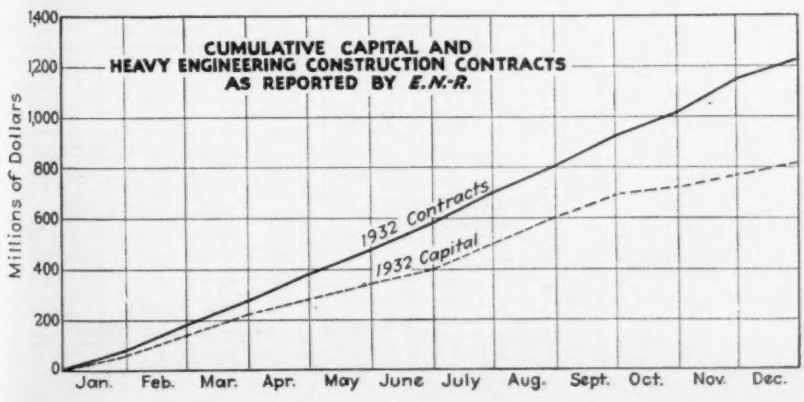
Engineering Contracts and Capital

BOOSTED BY THREE large awards, the engineering construction contracts reported for the past week total $38,329,000, a high figure surpassed only twice during the past year. The average of contracts awarded the last four weeks totals $23,547,000, while the weekly average of awards in January, 1932, was $23,395,000. Federal contracts for the past week slumped to a long-time low, amounting to only $675,000. State and municipal awards were the highest in a year, reaching $34,801,000. Private work was lower than usual with $2,853,000 in contracts being reported. Highway lettings gained over the previous week, amounting to $4,900,000, considered strong for this time of year. The earthwork, drainage and flood control classification jumped from a weekly average of 1.5 millions to $8,800,000. The three large contracts reported during the week are Coachella Range tunnels, totaling 33 miles in length, on the Colorado River aqueduct, day labor estimated at $18,000,000; San Gabriel Dam No. 1, Los Angeles County flood control system, $8,601,000; and the Quabbin Dike of the Swift River water supply development for the Metropolitan District of Boston, $999,000.

On the proposed list, a toll bridge project for Boston is estimated at $1,500,000; a nurses' home planned by Hudson County at Jersey City, N. J., will cost $1,250,000; and bids have been called for on Jan. 11 for a seawall and track relocation, Seattle, estimated at $1,200,000.

New capital issues reported during the week total only $3,600,000, all public issues. Productive capital reported for the year 1932 totals $814,237,000, including R.F.C. self-liquidating loans actually made, aggregating $15,737,000. R.F.C. loans approved last week amounted to $508,000, bringing the approved total to date to $146,535,000.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Jan., 1932	Four Weeks	Week Jan. 5, 1933
Federal government	$4,155	$2,754	$675
State and municipal	9,289	17,103	34,801
Total public	$13,444	$19,767	$35,476
Total private	9,951	3,780	2,853
Week s total	$23,395	$23,547	$38,329

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Dec., 1931	Four Weeks	Week Dec. 29, 1932
R.F.C. loans made	.....	$3,750	.....
New capital issues	$6,000	10,000	$3,600
Total	$6,000	$13,750	$3,600

Cumulative, Jan. 1 to date:		
1931 new capital		$2,022,000
1932 R.F.C. loans made	$15,737	
1932 new capital	798,500	
1932 total		$814,237
Decrease, 60 per cent.		
R.F.C. self-liquidating loans:		
Approved to date		$146,300
Actual loans made		15,737

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
January, 1933	**158.44**	**December, 1932**	**113**
December, 1932	158.46	November, 1932	137
January, 1932	162.48	December, 1931	133
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		

ENGINEERING NEWS-RECORD
VOLUME 110——NUMBER 1

ENGINEERING NEWS-RECORD is a consolidation of Engineering News and Engineering Record, effected in 1917. The Contractor was consolidated with Engineering News-Record in 1918.

Engineering News was founded in 1874 by George H. Frost, as The Engineer and Surveyor, which title subsequently became The Engineer, Architect and Surveyor, then Engineering News and American Railway Journal and finally Engineering News, under the editorships of D. McN. Stauffer, A. M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as The Plumber and Sanitary Engineer. The name was subsequently changed to The Sanitary Engineer, Engineering and Building Record, and, finally, to Engineering Record. During his ownership of the paper Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor of the paper in 1902 and was succeeded in 1913 by E. J. Mehren.

E. J. Mehren became editor of Engineering News-Record at the time of the consolidation in 1917, and was succeeded by Frank C. Wight in 1924. In July, 1928, F. E. Schmitt was appointed editor.

The editorial staff comprises: *New York:* F. E. Schmitt, editor; V. T. Boughton, managing editor; C. S. Hill, W. G. Bowman, H. W. Richardson and F. W. Herring. *Chicago:* W. W. De Berard. *Southeast:* S. T. Henry. *San Francisco:* N. A. Bowers, J. I. Ballard.

Business Side of Construction

December Loss in Construction Volume Less than Shown in 1931

HEAVY ENGINEERING construction contracts reported in December (five weeks) total $103,360,000, or an average of $20,700,000 per week. This is a loss of 17.6 per cent from the November weekly average of $25,100,000, but is considerably less than the loss of 27.9 per cent registered between November and December of 1931. Contracts for the year averaged $23,500,000 per week, as compared with $45,900,000 per week in 1931, a loss of 48.8 per cent. In the past month private contracts showed a gain in average weekly awards from 3.4 millions in November to 4.6 millions in December, while public works lettings dropped from a weekly average of 21.7 millions to 16.1 millions. Public building awards were the highest since last July, amounting to 5.1 millions per week, almost double the November weekly average of 2.9 millions. Highway lettings showed the effect of the winter season coupled with the slowing up of emergency federal aid awards, falling off to an average of $6,000,000 per week from a year's high in September of $15,400,000 per week. Federal awards held to the average of the previous two months, amounting to 6.1 millions per week.

In the geographical distribution of contracts gains were registered in the Middle Atlantic and Middle West districts, losses occurring in the other four districts.

Geographical distribution of heavy engineering construction contracts reported in December, 1932 (five weeks) in thousands of dollars. Federal contracts are included in regular classifications, but are also shown separately as a matter of record. Below are shown weekly average contract awards, in millions of dollars, for various classes of work and for different sections of the country.

Cement prices stiffening

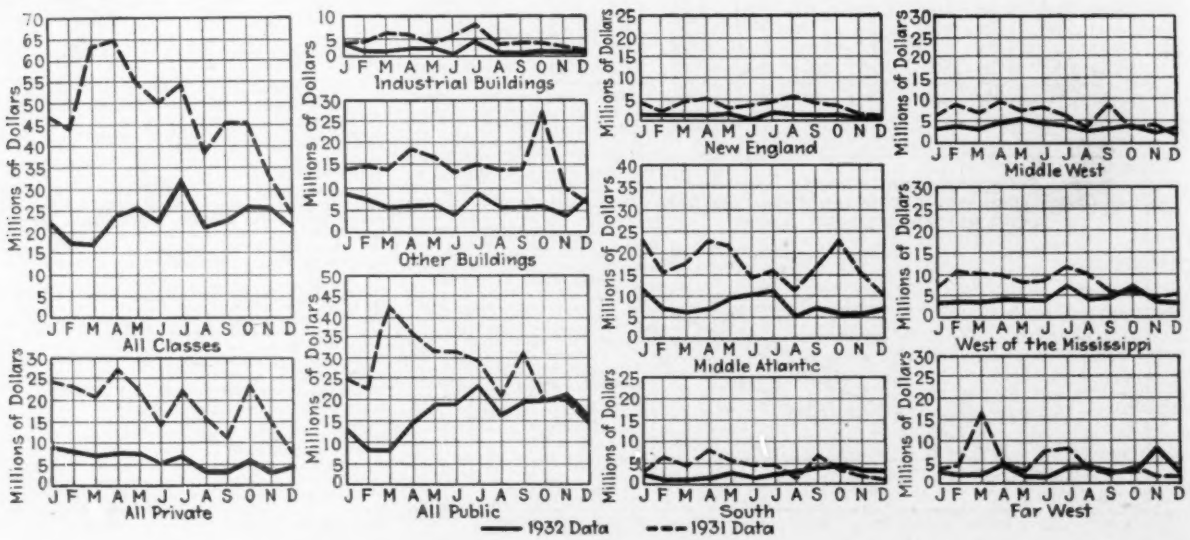
An increase in the price of portland cement was announced at several mills during the month. The increases per barrel and mill locations are as follows: Limedale, Ind., 10c.; La Salle, Ill., 10c.; Ironton, Ohio, 29c.; Buffington, Ind., 10c.; Hannibal, Mo., 10c.; and Universal, Pa., 19c.

The portland cement industry in November produced 6,464,000 bbl., shipped 4,782,000 bbl. and had in stock at the end of the month 18,764,000 bbl., according to the U. S. Bureau of Mines. Production during the month showed a decrease of

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN DECEMBER, 1932
Five Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States Dec., 1932	United States Twelve Months 1931	United States Twelve Months 1932	Canada Dec., 1932
Waterworks	68	466	121	611	81	7,837	9,184	56,413	34,586	40
Sewers	325	347	87	150	271	72	1,252	72,814	24,613	86
Bridges, public	227	1,217	682	1,768	1,931	316	6,141	103,842	79,557	.....
Earthwork and waterways	129	310	3,794	1,122	1,130	811	7,296	20,638	101,251	.....
Streets and roads	605	4,988	5,396	5,382	9,547	3,886	29,804	528,512	379,937	2,175
Unclassified, public	66	108	23	567	91	304	1,159	84,365	38,014	.....
Buildings, public	941	14,402	2,869	3,799	2,087	1,662	25,760	248,766	240,627	.....
Total public	2,291	21,838	12,972	13,399	15,138	14,888	80,596	1,396,310	898,885	2,301
Federal government (included in above classifications)	719	11,719	6,434	4,524	3,703	3,374	30,473	†280,960*	270,866	.....
Buildings, industrial	255	4,061	1,476	2,264	1,263	238	9,557	165,750	93,064	670
Buildings, commercial	155	9,837	469	1,215	283	.....	11,959	560,650	166,296	.....
Bridges, private	.....	75	.....	30	.....	40	145	11,184	581	.....
Earthwork, private	.....	.....	.....	.....	.....	.....	.....	.....	934	.....
Unclassified, private	109	336	95	112	243	208	1,103	298,420	56,155	.....
Total private	589	14,309	2,040	3,621	1,789	486	22,764	1,036,004	320,424	670
December, 1932 (5 weeks)	**2,880**	**36,147**	**15,012**	**17,020**	**16,927**	**15,374**	**103,360**	.....	.....	**2,971**
November, 1932 (4 weeks)	3,317	21,765	13,180	11,328	19,116	31,737	100,443	.....	.....	.....
December, 1931 (5 weeks)	12,083	53,086	8,012	18,266	25,073	8,611	.....	.....	.....	4,722
Year, 1932	71,636	403,830	127,815	205,423	236,205	174,400	.....	.....	1,219,309	51,459
Year, 1931	185,616	968,978	234,200	379,951	396,252	267,317	.....	2,432,314	.....	129,816

*Not included in other classifications.



20.8 per cent and shipments a decrease of 33.2 per cent from the same month last year. Stocks were 15.5 per cent lower than a year ago. In the ratio of production to capacity, November was 29.1 per cent, as compared with 34.6 per cent for October and 37.2 per cent for November, 1931.

Lumber production low

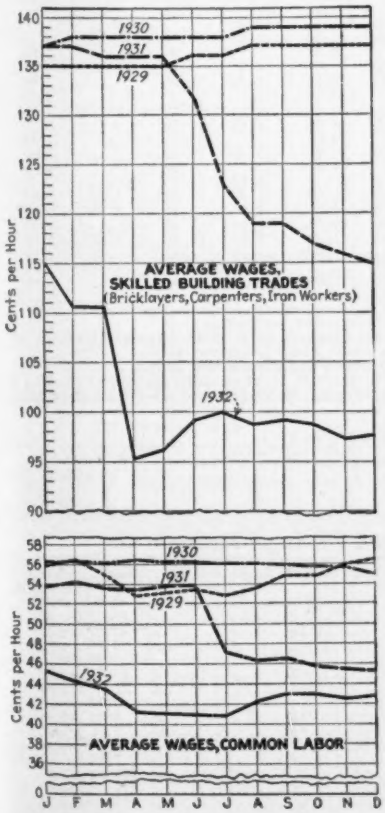
With December normally one of the two lowest months of the year in the production of lumber, output reached the lowest point of the year during the week of Dec. 24. For the month of December, production averaged 19 per cent of normal capacity and 37 per cent of the average of the past three years. For the year production averaged 22 per cent of normal and 39 per cent of a 3-year average. Orders received during the month averaged 125 per cent of production. The year's orders were 123 per cent of production and 68.5 per cent of 1931. Shipments during December amounted to 107 per cent of production, and for the year, 125 per cent of production, indicating a considerable reduction in mill stocks. These figures are from the records of the National Lumber Manufacturers Ass'n.

Steel output declines

Production of steel declined from 16 to 17 per cent of capacity early in December to about 14 per cent during the closing days of the month in the Pittsburgh area. Output at Chicago slumped to about 10 per cent of capacity. A few rail orders were forthcoming, but on the whole this class of buying was disappointing to the industry. A considerable tonnage of rails has been authorized by railroads, and orders are looked for early in the year. Structural buying was spasmodic and generally low.

The monthly report of the American Iron & Steel Institute shows an estimated production for November of 1,014,794 tons, or 18.05 per cent of capacity, as compared with 1,068,550 tons in October, rated at 19 per cent of capacity. Production during the eleven months of the year totaled 12,251,109 tons, or 19.81 per cent of capacity. In 1931 there were 23,891,504 tons of steel produced, which is rated at 39.46 per cent of capacity.

Skilled and common average wage rates for the past four years. Skilled rates are the average of bricklayers, carpenters and ironworkers for twenty cities. Common rates are average for the same twenty cities.



Labor notes

With this issue we are resuming publication of average skilled and common labor rates. The skilled rates are the average of three trades, bricklayers, carpenters and ironworkers in twenty cities. The common rates are the average reported in the same twenty cities. Skilled rates show an increase from the last two months, averaging 98.92c. Jan. 1. The average of 1932 rates is $1.015. Common labor rates have shown little change during the past four months, the current average being 42.71c. Average for last year is 42.69c.

San Francisco—The board of supervisors of the city has set a wage scale on municipal public works on a higher hourly basis than the scale recently announced for private work by the Impartial Wage Board, but set a 30-hour week as standard. The hourly rates will prevail for 6 hours per day, 5 days per week, which in reality lowers the weekly scale by 25 per cent.

United States—The American Federation of Labor reports 10,980,000 unemployed early in December including an estimated increase of 28,000 during November. Trade union employment decreased less during October and November than during any previous years in which records have been kept. Weighted figures show the per centage of unemployed at 25.4 for July, 25.1 for August, 24.8 for September, 23.9 for October and 24.1 for November.

New York State—The Department of Labor reports the number of applicants for every 100 positions offered during November as 502.3, as compared with 434.1 for October and 393.9 for September. The highest index for the year was July, 597.2.

ENR Cost and Volume Index

The *ENR* Cost Index for January, 158.44, is almost identical with the December Index. An increase in the cement price element was offset by a corresponding decrease in the price element of lumber. The 1932 average of the Cost Index was 156.97, as compared with 181.35 for 1931 and 202.35 for 1930. The *ENR* Volume Index for December is 113, as compared with 137 for November and October, a decrease of 18 per cent. In 1931 the December index was 133, a decrease of 26 per cent from the November figure of that year, 180 and a decrease of 42 per cent from the 229 figure of October. The average of the Volume Index in 1932 was 127, as compared with a 1931 average of 220 and a 1930 average of 260.

E.N.-R. Cost		E.N.-R. Volume	
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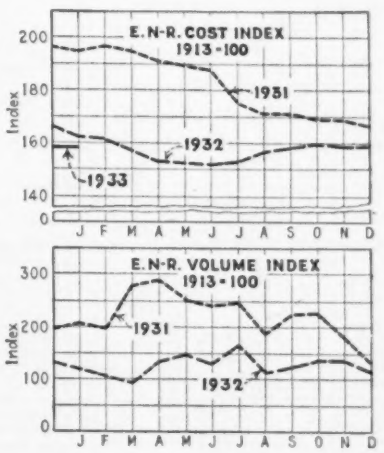

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structural Iron Workers	Masons' Laborers	Common Laborers
Atlanta	$0.75@1.12½	$0.40@.90	$0.60@1.25	.....	$0.60@1.25	$0.25	$0.20@.25
Baltimore	.62½@1.00	.65@.90	1.37½	$0.65	1.25	.40	.30
Birmingham	.75@.87½	.60	.75	.....	.75	.25	.20@.30
Boston	.90@1.30	.70@1.17½	1.00@1.17½	.70@1.07½	1.00@1.20	.45@.70	.40@.70
Cincinnati	1.27½	1.02½	1.07½	1.07½	1.20	.70	.40@.45
Chicago	1.37½	1.31½	1.31½	1.31½	1.35	.82½	.50@.82
Cleveland	.90@1.37½	.75@1.12½	.90@1.12½	1.00	.90@1.06¼	.56¼	.30@.72
Dallas	.62½	.50	.50	.50	.50	.25	.25@.35
Denver	1.00@1.12½	.75@.87½	.75@.87½	.....	.75@.87½	.50	.31¼@.50
Detroit	.75@1.50	.55@.80	1.25	1.25	1.25	.70	.30@.50
Kansas City	1.30	1.12½	1.12½	1.06	1.12½	.82½	.35@.40
Los Angeles	.62½	.50	.75	.75	.75	.50	.35@.50
Minneapolis	.90@1.00	.75	.75	.....	.90	.50	.40@.50
New Orleans	.60@.80	.40@.50	.80@1.12½	.90	.80@1.12½	.50	.15@.20
New York	1.50@1.65	1.25@1.40	1.50@1.65	1.50	1.65	.81¼@1.00	.50@.75
Philadelphia	1.00@1.25	.60@.90	1.00	.75	1.00	.30@.40	.20@.30
Pittsburgh	.60@1.50	.60@1.25	.60@1.37½	1.00@1.18¾	.60@1.37½	.50	.40@.70
St. Louis	1.50	1.25	1.35@1.47	1.25	1.47	1.00	.35@.78¾
San Francisco	1.12½	.90	1.00	1.00	1.20	.65	.65
Seattle	.75@1.20	.50@.90	1.00	.90	1.10	.66	.40@.50
Montreal	.75	.60	.55	.....	.70	.45	.25@.30

Skilled Average (3 trades) .989. Common Average, .427.

Current Prices of Construction Materials

Building Materials

PORTLAND CEMENT — Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered		F.o.b.	Delivered
Atlanta	$2.33	$2.85	Kansas City	$1.60	$1.70
Baltimore	....	2.03	Los Angeles	2.10	2.10
Birmingham	2.02	2.12	Minneapolis	2.10	2.25
Boston	1.58	1.68	Montreal	1.70	....
Chicago	1.60	1.95	New Orleans	1.90	2.20
Cincinnati	1.37	1.52	New York	1.59	1.80
Cleveland	1.77	2.00	Philadelphia	1.84	1.94
Dallas	2.80	3.00	Pittsburgh	1.68	1.78
Denver	....	2.40	St. Louis	1.74	2.15
Detroit	1.47	1.80	San Francisco	2.05	....
			Seattle	2.55	2.70

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich	$1.20	Mason City, Ia	$1.35
Buffington, Ind	1.35	Norfolk, Va	1.61
Dallas, Tex. (Inc. 5c. tax)	1.75	Northampton, Pa	1.40
Hannibal, Mo	1.35	North Birmingham, Ala	1.60
Hudson, N. Y	1.50	Richard City, Tenn	1.70
Independence, Kan	1.35	Steelton, Minn	1.45
Ironton, Ohio	1.35	Universal, Pa	1.40
Iola, Kan	1.35	Waco, Tex	1.75
La Salle, Ill	1.35	Wyandotte, Mich	1.20
Limedale, Ind	1.35		

SAND AND GRAVEL — Per ton, carload lots, gravel, size ¾-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.55	....	2.08
Birmingham, per cu.yd	....	3.00	....	2.40
Boston	1.40	1.65	.90	1.15
Chicago, per cu.yd	....	2.25	....	2.25
Cincinnati	1.20	1.65	.95	1.40
Cleveland	....	2.00	1.40	2.00
Dallas, per cu.yd	1.40	2.40	1.65	2.40
Denver, per cu.yd	1.75	1.85	1.15	1.20
Detroit	.50	1.45	.72	1.50
Kansas City	.75	....	.60	....
Los Angeles	1.35	1.45	.85	1.00
Minneapolis	....	1.60	....	.65
New Orleans	1.50	2.50*	1.20	2.00*
New York, per cu.yd	1.60	3.25	1.00	2.00
Philadelphia	....	1.66	....	1.38
Pittsburgh	....	1.20	....	1.40
St. Louis	.80	1.25	.80	1.25
San Francisco	1.65	....	1.65	....
Seattle, per cu.yd	1.75	....	1.75	....

*Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	.80	1.05
Boston	1.40	1.65
Chicago, per cu.yd, 2,500 lb	....	2.25
Cincinnati	1.65	1.85
Cleveland	....	2.00
Dallas, per cu.yd., 2,500 lb	1.65	3.00
Denver, granite, per cu.yd., 2,700 lb	....	2.50
Detroit	1.09	1.95
Kansas City	1.25	....
Los Angeles	1.35	1.45
Minneapolis	....	1.60
New York, per cu.yd., 2,800@3,000 lb	1.65	3.25
Philadelphia	....	2.00
Pittsburgh	....	2.25
St. Louis	1.35	1.50
San Francisco, trap rock	1.65	....
Seattle, per cu.yd., 3,000 lb	1.10	....

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Slag Sand
Birmingham	$0.90	$1.15	$2.05	$0.55
Buffalo	1.35	1.35	1.85	1.25
Cleveland	1.70	1.70	....	1.35
Toledo	1.20	1.20	1.20	1.10
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown	1.10	1.20	2.00	.75

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Baltimore (8x12x12)	$0.20	Kansas City	$0.18
Birmingham (5x8x12)	.084	Los Angeles	.15
Boston	.14	Minneapolis	.08
Brooklyn and Queens	.12	Montreal	.14
Chicago	.175	New Orleans	.16
Cleveland	.165	Philadelphia	.15
Denver	.15	Pittsburgh	.14
Detroit	.08	St. Louis	.14

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered 50 cu.yd. or more:

Atlanta	$7.75	Los Angeles	$5.40
Birmingham	6.90	Minneapolis	6.00
Boston	6.25	New Orleans	6.20
Cincinnati	6.10	New York (Manhattan)	8.50
Dallas	6.25	Philadelphia	5.98
Detroit 1:2½:5	4.75	Pittsburgh	5.75
Kansas City	7.50	St.Louis	6.80
		Seattle	5.35

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.10	.14	.20	.22	.30
Birmingham	.089	.122	.167	.219	.25
Boston (at plant)	.075	.11	.14	.20	.30
Chicago	.0484	.063	.09	.1179	.13
Cincinnati	.06815	.....	.....	.165	.....
Cleveland	.048	.066	.09	.117	.13
Dallas	.067	.....	.....	.173	.....
Denver	.085	.135	.175	.19	.25
Detroit	.0505	.065	.0947	.1175	.1305
Kansas City	.0735	.092	.15	.1777	.20725
Los Angeles	.09425	.134	.188	.2325	.3115
Minneapolis	.0635	.09395	.1232	.13425	.2103
New Orleans	.085	.115	.16	.225	.255
New York	.075	.1164	.1455	.....	.....
Perth Amboy	.....	.....	.....	.2388*	.2956*
Philadelphia	.065	.093	.14	.175	.195
Pittsburgh	.0435	.065	.088	.1165	.126
St. Louis	.06	.083	.112	.155	.195
San Francisco	.0765	.105	.1765	.....	.....
Seattle	.085	.115	.18	.....	.....

*At plant. (Load-bearing tile).

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Paving
	F.o.b.	Delivered	F.o.b. 3x8½x4-in.
Atlanta	$8.50	$14.00	$32.00
Baltimore	.....	11.50	43.00†
Birmingham	10.00	12.50	25.00
Boston	12.00	16.00	42.00
Chicago	.....	9.00	32.00
Cincinnati	13.50	16.00	36.50
Cleveland	12.00	14.00	33.00
Dallas	11.00	12.50	25.00†
Denver	13.00	.....	40.00
Detroit	11.50	12.50	25.00
Kansas City	12.00	13.00	35.00
Los Angeles	.....	8.50	.....
Minneapolis	.....	7.50	.....
Montreal	21.50	.....	.....
New Orleans	10.50	14.50	40.00
New York	9.50	12.50	45.00
Philadelphia	.....	13.00	40.00
Pittsburgh	11.00	13.00	35.00
St. Louis	.....	12.00	32.00†
San Francisco	.....	14.00	45.00*
Seattle	12.00	14.00	.....

*2½x8½x4 in. †3½x8½x4 in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net:

	Hydrated				Common Lump	
	Finishing		Common			
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	.....	$2.50
Baltimore	....	20.00	.....	13.00	.....	....
Birmingham	21.00	.....	12.00	.....	1.65	.....
Boston	14.00	16.00	12.00	14.00	$2.35*	3.25*
Chicago	.....	20.00	.....	14.00	.....	2.75
Cincinnati	10.00	11.00	8.65	9.65	.....	.....
Cleveland	10.50	14.00	8.50	12.00	.....	2.50
Dallas	.....	20.00	.....	.....	.....	2.50
Denver	.....	30.00	.....	22.00	.....	2.85*
Detroit	9.25	14.00	7.25	12.00	.....	.....
Kansas City	.....	22.00	.....	.....	.....	2.75
Los Angeles	24.00	26.00	17.00	18.00	.....	2.00
Minneapolis	.....	21.00	.....	19.00	.....	1.70
Montreal	.....	.....	12.00	13.00	.....	.....
New Orleans	13.50	21.00	11.00	14.00	1.66	1.95
New York	10.70	14.50	8.60	12.50	2.25*	3.15*
Philadelphia	11.50	15.39	9.90	13.49	.....	1.18
Pittsburgh	10.70	12.20	9.95	11.45	1.85	2.35
St. Louis	.....	.45‡	.....	.40‡	.....	2.15
San Francisco	19.00	.....	19.00	.....	1.59	.....
Seattle	.....	32.00	.....	24.00	.....	2.80

*Per 280-lb. bbl. (net.) ‡Per sack.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:
New York:* Rustic buff, $1.48; Standard gray, $1.48; Standard buff, $1.58; Selected gray, $1.58; Selected buff, $1.68; Variegated, $1.48.
Boston: Rustic buff, $1.47; Standard, $1.57; Selected buff, $1.67.
Pittsburgh: Rustic buff, $1.14; Standard, $1.24 at quarry; Selected buff, $1.34.
Philadelphia: Sel. buff, $1.59; Sel. gray, $1.49; Standard, $1.49; Standard gray, $1.39; Rustic buff, $1.39.
Atlanta: Standard $1.26.
*F.o.b. Bedford, freight allowed to N. Y.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square;

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.
Baltimore	43.00 per M.
Birmingham (3½x8½x4-in.)	76.25 per M.
Boston	85.00 per M.
Chicago, 5 in	3.80 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	95.00 per M.
Dallas	25.00 per M.
Detroit, 5 in	2.80 per sq.yd.
Kansas City	3.00 per sq.yd
Minneapolis, 4½ in	2.80 per sq.yd
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in	135.00 per M.
Philadelphia, 4x10x5	115.00 per M.
Pittsburgh	115.00 per M.
St. Louis, 5 in	2.65 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING — Prices f.o.b., in carload lots:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.00
Chicago	3½	12	1.90
Kansas City	3½	16	2.65
Minneapolis	3½	16	2.25
Montreal	3½	16	2.63
New York	3½	14	1.90
Philadelphia	3½	16	2.02
St. Louis	3½	16	2.10

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	New York	$0.62
Birmingham	.50	Philadelphia (6x20 dressed)	1.40
Boston	.70	Pittsburgh	.80
Dallas	.60	St. Louis	.65
Detroit	.45		

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$21.60	$17.40
Baltimore (f.o.b. refinery)	17.00	13.00
Bayonne (f.o.b. refinery)	17.00	13.00
Birmingham	.....	11.00
Boston	20.00	16.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	.....	8.00
Cleveland	18.25	14.50
Dallas	.....	27.00
Denver	27.50	.....
Detroit	16.80	12.43
Kansas City (f.o.b. refinery)	16.00	.....
Los Angeles (f.o.b. refinery)	18.00	12.00
Maurer, N. J. (Bermudez)	.....	26.00
Maurer, N. J. (Trinidad)	.....	22.00
Minneapolis (f.o.b. Twin Cities)	21.30	16.30
Montreal (f.o.b. factory)	17.00	13.00
New Orleans (f.o.b. refinery)	16.00	12.00
New York	19.00	15.00
Philadelphia	17.00	11.00
Pittsburgh	25.00	16.00
St. Louis	19.70	15.70
San Francisco (f.o.b. refinery)	16.00	10.00
Seattle	21.10	14.00

LIQUID ASPHALT — Residual, hot application, f.o.b., in tank cars. 8,000 gal. minimum, per gal.:

Atlanta	$0.0539
Bayonne and Baltimore refineries	.05
Birmingham	.06
Boston	.055
Cincinnati	.075
Dallas	.05
Kansas City	.05
Los Angeles	.045
Montreal at (refinery)	.09
New York	.06
Philadelphia	.08
Pittsburgh	.05
St. Louis	.06

EMULSIFIED ASPHALT — For penetration and surface treatment, per gal.:

Boston, applied	$0.11
Cincinnati, f.o.b. refinery	.06
Los Angeles, applied	.11
Des Moines, applied	.12
New York, applied	.15
Philadelphia, applied	.13
Pitt burgh f.o.b. refinery	.04@.06
St. Louis, applied	.12
Seattle, f.o.b. refinery	.055

Iron and Steel

	Pittsburgh	Chicago	Birmingham
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.60	$1.70	$1.75
CONCRETE REINFORCING BARS, ¼ in., billet, per 100 lb., carload lots	1.60	1.65	1.75
SHEETS, per 100 lb., carload lots:			
Hot-rolled No. 10	1.55	1.65	1.85
Hot-rolled annealed No. 24	2.15	2.30	2.35
Galvanized No. 24	2.85	2.95	3.00
TERNE PLATES, per package, I.C., 8-lb. coating, 20x28 in.	9.50	.....	.....
RIVETS per 100 lb., ½ in., structural, carload lots	2.25	2.35	2.70
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....
WIRE NAILS, per 100 lb., base, carload lots	1.95	2.00	2.40
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	8.75	6.75	7@7.50

TRIANGLE MESH—Plain, per 100 sq.ft., in carload lots:

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	4x4	22	$0.85	$0.86
049	4x4	28	1.07	1.10
068	4x4	35	1.30	1.34
093	4x4	45	1.68	1.72
126	4x4	57	2.08	2.13
153	4x4	68	2.47	2.54
180	4x4	78	2.84	2.92
245	4x4	103	3.75	3.84
287	4x4	119	4.34	4.35
336	4x4	138	5.03	5.16
395	4x4	160	5.83	5.98
036P	4x8	17	.64	.66
053P	4x8	24	.91	.93

TRIANGLE MESH—*Continued*

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mi
072P	4x8	31	1.14	1.17
097P	4x8	40	1.48	1.51
049R	4x8	24	.91	.93
067R	4x8	31	1.14	1.17
089R	4x8	40	1.48	1.51

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½%
Galvanized steel rigging and guy rope	12½%
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½%

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd., painted, f.o.b., in carload lots 2.2 lb. per sq.yd., standard-mesh diamond lath:

Atlanta	$20.00*	Los Angeles	$17.00
Birmingham	17.00	Montreal (2.5 lb.)	24.00
Boston	15.00	New Orleans	20.00
Chicago	10.60	New York	13.50
Cincinnati	11.00	Philadelphia	13.50
Dallas	18.00	Pittsburgh	13.50
Detroit	18.00*	St. Louis	19.00*
Kansas City	17.00*	San Francisco	17.00*
*Delivered.		Seattle	19.00

STEEL FREIGHT RATES — Per 100 lb., effective Dec. 3, 1931, on finished steel products in the Pittsburgh District, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.; 40,000 lb. per car:

Atlanta, 36,000 lb.	$0.60	Detroit	$0.285
Baltimore	.29	Kansas City	.59
Birmingham	.60	New Orleans, 36,000 lb.	.69
Boston	.42	New York, 40,000 lb.	.35
Buffalo	.255	Pacific Coast, 60,000 lb.	1.17*
Chicago	.36	Philadelphia	.31
Cincinnati	.285	St. Louis	.41
Cleveland	.205	St. Paul	.60
Denver	.92	* All rail.	

Railway Materials and Supplies

STEEL RAILS — Per gross for, f.o.b.

	Pittsburgh	Birmingham	Chicago
Standard rails	$40.00	$40.00	$40.00
Light rails	30.00	32.00	34.00
Re-rolled rails	26.00	.....	27.00

RAILWAY TIES — Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$0.90	.....
	Pine, untreated	.85	.....
	Pine, creosoted	1.40	.....
New York	Long-leaf sap pine, untreated	.90	$1.10
	Dense yellow pine, untreated	.60	.80
Birmingham	White oak, untreated	.75	.95
	White oak, creosoted	1.35	1.45
	Southern pine, untreated	.35	.80
	Southern pine, creosoted	.95	1.35
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
Los Angeles	Fir, untreated	.45	.....
	Fir, creosoted	1.15	.....
Philadelphia	Red oak, untreated	.95	1.15
	Red oak, creosoted	1.47	1.90
St. Louis	White oak, untreated	.75	1.25
	Red oak, untreated	.70	1.05
	Red oak, creosoted	1.05	1.65
	Sap pine or cypress, untreated	.60	1.00
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f.o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Angle bars	$2.55	$2.75	$2.75
Standard spikes	2.40	2.40	2.60
Tie plates	1.75	1.85	1.85
Track bolts	3.50	3.50	3.50

Pipe

WROUGHT STEEL PIPE — Discounts from standard list for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Boston	55.5%	42.25%	51.35%	40.1%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
Denver	44.5%	32%	41%	28.5%
New York	56.14%	43.6%	52.72%	40.18%
Philadelphia	57.28%	44.68%	53.68%	41.80%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	51%	38%	48%	35%

Current Prices of Construction Materials

Pipe—Continued

CAST-IRON PIPE — Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots; gas pipe and Class A, $3.00 per ton extra:

	4-In.	6-In. and Over
Atlanta	$37.50	$34.50
Boston	41.00	38.00
Birmingham (Base)	33.00	30.00
Burlington (Base)	35.00	32.00
Chicago	41.50	38.50
Dallas	45.50	42.50
Los Angeles	41.50	38.50
New York	38.50	35.50
Philadelphia (rail delivery)	36.50	33.50
Pittsburgh	41.50	38.50
St. Louis	40.50	37.50
San Francisco	41.50	38.50

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.125	$0.21	$0.385	.....	$1.40	.....	.....
Baltimore	.10	.30	.58	.....	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.16	.25	.50	1.25	2.10	4.40	5.50
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.0945	.....	.2835	.....	1.125	2.448	.....
Cleveland	.135	.21	.405	1.125	2.025	4.824	7.38
Dallas	.236	.....	.7165	.....	2.70	.....	.....
Denver	.16	.23	.414	.816	1.44	.....	.....
Detroit	.0855	.....	.2625	.....	1.90	3.80	.....
Kansas City	.21	.335	.52	1.00	1.90	3.80	.....
Los Angeles(f.o.b.)	.2175	.2825	.5085	1.1865	2.034	3.69	.....
Minneapolis	.18	.23	.46	1.20	1.85	3.20	4.26
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.18	.30	.54	1.02	1.95	.....	.....
New York	.13	.21	.42	1.15	2.10	.....	.....
Philadelphia	.081	.126	.243	.65	1.17	2.376	4.615
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.112	.20	.36	.945	1.62	2.80	3.80
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.21	.30	.54	1.26	2.16	3.60	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Atlanta	$50.00	Los Angeles	$60.00
Birmingham	50.00	New Orleans	40.00
Boston	40.00	New York	35.00
Chicago	40.00	Philadelphia	36.00
Dallas	65.00	Pittsburgh	80.00
Denver	75.00	St. Louis	40.00
Detroit	40.00	San Francisco	67.50
Kansas City	70.00	Seattle	42.50

Miscellaneous

LINSEED OIL—Raw, in 5-bbl. lots, per lb., f.o.b.:

Atlanta	$0.075	Minneapolis	$0.078
Birmingham	.066	Montreal (per gal.)	.47
Boston (per gal. delivered)	.59	New York	.074
Dallas (per gal.)	.555	Philadelphia	.064
Denver (per gal.)	.69	Seattle (per gal.)	.67
Kansas City (per gal.)	.51	St Louis	.082
Los Angeles	.0813	San Francisco (del)	.1125

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Atlanta	$12.50	Montreal	$ 8.20
Birmingham	12.50	New Orleans	11.00
Boston	12.00	New York	11.00
Dallas	14.00	Philadelphia	9.50
Kansas City	12.50	Seattle	11.00
Los Angeles	11.50	St. Louis	12.00

Note: Both white and red lead, dry, same prices as foregoing; red in oil, $1.50 higher

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75@2.00
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competion, per ton	21.00
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in bags, per 100 lb.	1.22½
Sulphate of aluminum, in bags, per 100 lb.	1.25@1.40
Sulphate of copper, in bbl., per 100 lb.	3.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¼-in., 6-ft.; ½-in., 1½-ft.; ¾-in., 4-ft., 1-in., 3-ft., 1¼-in., 2-ft., 1½-in., 1½-ft., 2-in. Following prices are per lb. for ¼-in. and larger, delivered in 1,200 ft. coils:

Atlanta	$0.18	Kansas City	$0.21
Baltimore	.225	Los Angeles	.1725
Birmingham	.20	Minneapolis	.175
Boston	.16	Montreal	.1625
Chicago	.175	New Orleans	.175
Cincinnati (f.o.b.)	.21	New York	.16
Cleveland	.21	Philadelphia	.15
Dallas	.18	St. Louis	.155
Denver	.18	San Francisco	.155
Detroit	.185	Seattle	.155

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point $2.40

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.70

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Atlanta	$5.85	$6.25	$2.05
Boston	6.25	6.00	2.50
Dallas	4.50	3.60	1.90
Detroit	6.25	6.50	1.85
Montreal	6.40	6.20	2.68
New Orleans	5.60	5.50	2.00
New York	6.50	6.25	2.50
Philadelphia	4.40	4.20	1.60
Seattle	8.75	5.50	2.25
St. Louis	7.30	6.35	1.89

*Slate finish, sufficient to cover 100 sq.ft. ‡Slate surfaced, in rolls weighing 85 to 90 lb. †4 in 1, hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch,* per Ton
Atlanta	$44.50†	$44.50†	$0.45	$44.50
Boston	2.40	2.40	0.33	27.00
Dallas	3.17	3.00	.75	38.00
Denver	2.00	2.00	.90	18.00
Montreal	2.62‡	2.02‡	1.40	1.63**
New Orleans	.....	2.50	.....	22.50
New York	2.40	2.40	.34½	28.00
Philadelphia	2.25	2.25	.33	20.00
Seattle	2.40	2.40	.55	27.90
St. Louis	2.51	....	.28	26.00

*In 350 lb. barrels. †Per ton. ‡Per roll. **Per English cwt.

WINDOW GLASS—Discounts from latest jobbers list, dated Sept. 15, 1928 for sizes above first three brackets:

	Single Thickness		Double Thickness	
	A Quality	B Quality	A Quality	B Quality
Atlanta	85%	85%	85%	85%
Birmingham	89%	91%	89%	91%
Boston	88%	90%	87%	89%
Dallas	85%	85%	85%	85%
Denver	84@5%	86@5%	84@5%	86@5%
Kansas City	90@5%	90@5%	90@5%	90@5%
New York	87%	89%	87%	89%
Philadelphia	88%	90%	88%	90%
Pittsburgh	90%	90%	90%	90%
Seattle	90@10%	90@20%	90@10%	90@20%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.215	$0.2375	Los Angeles†	$0.1725	$0.1925
Baltimore	.21	.255	Minneapolis	.18	.195
Birmingham	.13	.1525	Montreal	.1675	.1925
Boston	.225	.25	New Orleans	.19	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati (f.o.b.)	.22	.245	Philadelphia	.215	.24
Dallas	.22	.24	St. Louis	.145	.165
Denver	.19*	.21*	San Francisco	.1575	.1825
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*F.o.b Louviers. †F.o.b. arsenal.

Lumber

LUMBER—Per M. ft., b.m., No. 1, Common, rough, in carload lots:

SOUTHERN L. L. YELLOW PINE

	1 x 6 In.* F.o.b.	1 x 6 In.* Del.	1 x 8 In.* F.o.b.	1 x 8 In.* Del.	3 x 12 In.† F.o.b.	3 x 12 In.† Del.	12 x 12 In.† F.o.b.
Atlanta	$14.00	.....	$15.00	.....	$35.00	.....	$45.00
Baltimore	.....	$40.00	.....	$43.00	.....	$42.00	35.00
Birmingham	.....	15.00	.....	15.00	.....	18.00	25.00
Boston	27.00	32.00	29.00	34.00	45.00	50.00	60.00
Chicago	.....	.....	.....	.....	.....	62.50	.....
Cincinnati	.....	28.00	.....	28.00	.....	35.00	35.00
Cleveland	30.00	38.00	32.00	40.00	46.00	54.00	.....
Dallas	.....	27.50	.....	27.50	.....	52.50	52.50
Denver	.....	31.00	.....	33.00	.....	45.00	.....
Detroit	30.00	32.00	30.00	32.00	32.00	32.00	45.00
Kansas City	24.00	.....	21.00	.....	46.00	.....	.....
Minneapolis	.....	31.00	.....	31.00	.....	34.00	.....
Montreal	44.00	.....	45.00	.....	30.00	.....	.....
New Orleans	.....	18.00	.....	19.00	.....	50.00	.....
New York	22.00	24.00	23.00	25.00	50.00	52.50	50.00
Phil. No. 2 (com.)	19.00	23.00	20.00	24.00	28.00	32.00	46.00
Pittsburgh	20.00	33.00	20.00	33.00	32.00	39.00	46.00
St. Louis	23.00	28.00	23.00	28.00	43.50	48.50	41.50

DOUGLAS FIR

	1 x 6 In.* F.o.b.	1 x 6 In.* Del.	1 x 8 In.* F.o.b.	1 x 8 In.* Del.	3 x 12 In.† F.o.b.	3 x 12 In.† Del.	12 x 12 In.† F.o.b.
Baltimore	.....	$48.00	.....	$52.00	.....	$58.50	$70 00
Boston	$25.00	30.00	$27.00	32.00	$31.00	36.00	43.00
Chicago	.....	.....	.....	.....	.....	44.52	.....
Cincinnati	.....	.....	.....	.....	.....	42.50	42.50
Cleveland	30.00	38.00	32.00	40.00	40.00	54.00	.....
Denver	31.00	.....	33.00	.....	46.00	.....	50.00
Detroit	.....	.....	.....	.....	30.00	30.00	45.00
Kansas City	30.00	.....	33.00	.....	42.00	.....	39.00
Minneapolis	.....	31.00	.....	31.50	.....	36.00	.....
New Orleans	.....	21.00	.....	21.00	.....	42.50	.....
New York	19.00	21.00	20.00	22.00	22.50	24.50	24.00
Philadelphia	.....	.....	.....	.....	.....	28.00	30.00
Pittsburgh	.....	.....	.....	.....	58.00	63.00	48.00
St. Louis	28.50	33.50	28.50	33.50	31.00	36.00	31.00
San Francisco	.....	15.00	.....	16.00	.....	17.00	17.00
Seattle	10.00	11.00	12.00	13.00	12.00	13.00	12.00

*Form lumber, 16 ft. lengths. †Planks and timbers, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442